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JULY 1997
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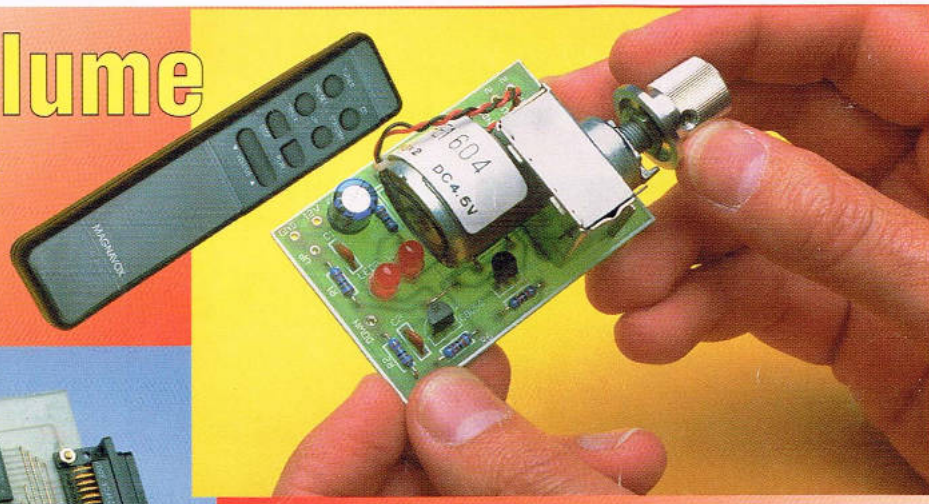

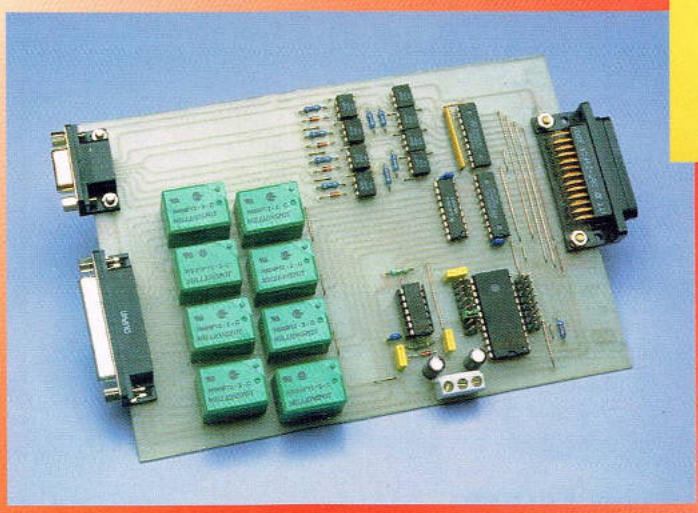

Interfacing Your Computer to the Real World

GETTING THE BIG PICTURE:

The Inside Story on Philips' Huge New Rear-Projection TV

PLUS:

- Points controller for model trains
- Low-cost waveform generator
- Building the TV pattern generator

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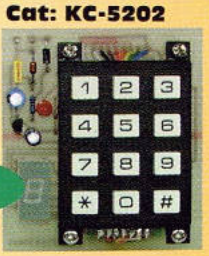

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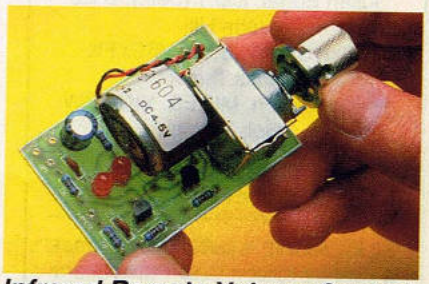

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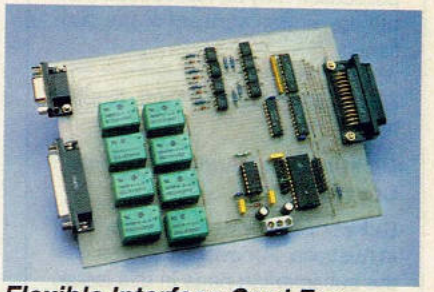

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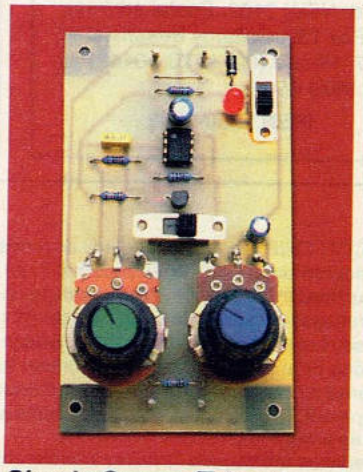

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Printing: Macquarie Print, Dubbo, NSW.

Distribution: Network Distribution Company.

Subscription rates: $54 per year in Australia. For overseas rates, see the subscription page in this issue.

Editorial & advertising offices: Unit 34, 1-3 Jubilee Avenue, Warriewood, NSW 2102. Postal address: PO Box 139, Collaroy Beach, NSW 2097. Phone (02) 9979 5644. Fax (02) 9979 6503.

ISSN 1030-2662

PUBLISHER'S LETTER

Backing up is not hard to do

These days most of us have a computer or have access to a computer and so most people are familiar with the concept of backing up their work. The reasons for doing so are plain commonsense. If you do have a computer failure and you have religiously backed up your files, then you won't have lost a lot of work.

I'm not just thinking about people in business in raising this topic. Many people with computers in their homes use them for quite crucial aspects of their lives. Students use them for writing essay assignments, for keeping track of research work and for writing theses. For an undergraduate to lose most or all of a thesis would be traumatic indeed.

Similarly, people might use their computer for club records, for their medical records, financial records, share dealings, hobbies and so on. In every case, the loss of all this information can happen so quickly, in the blink of an eye so to speak, that the event can be emotionally shattering. And financially shattering as well. And since hard discs are becoming larger all the time, the size of the potential data loss is also growing, at an exponential rate.

Just recently, one of the machines in the SILICON CHIP office had such an event. One moment the machine was working perfectly normally, as it always had since the day it was purchased. The next moment, there was a screen message to say that one of the 1.6GB discs was unreadable. Just like that!

As it happened, we were just about to replace that particular disc drive with one of 3.2 gigabytes so the physical loss of the drive was of no particular concern. It turned out not be damaged anyway. But what about the files? Well, running CHKDSK produced many hundreds of files which all had to be renamed and then imported to be checked. Many were OK but some were not. The upshot was that we lost several days of work on this machine.

All of this was in spite of the fact that we have backup procedures in place, whereby all working files are copied to the server every day and all those files are then backed up onto a DAT drive. Its capacity is 8GB. In theory, all we should ever lose, even if the server and all our computers were stolen or destroyed in a fire, would be one day's work. But in practice, who knows? In fact, this one machine and the server's drives were so full that the backup procedure had become a little loose. We could have lost a lot more work.

We often hear of much worse cases, where people have not backed up anything for weeks, months or maybe never. Sooner or later, those people will suffer the consequences.

Leo Simpson

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

Advertisers are warned that they are responsible for the content of all advertisements and that they must conform to the Trade Practices Act 1974 or as subsequently amended and to any governmental regulations which are applicable.

FIBRE OPTIC NIGHT VISION TUBES
Used US-made night vision tubes with blemishes. Have 25/40mm diameter, fibre-optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60mm long; the 40mm tube has an overall diameter of 80mm and is 92mm long. Produces a good image in approximately 1/2 moon illumination, when used with a suitable lens, but can also be IR assisted to see in total darkness: 880nm illuminator is suitable. Excellent resolution, suitable for low-light video preamplifiers, etc. Each of the tubes is supplied with an EHT power supply kit that operates from 9V DC: **$60** for a slightly blemished 25mm intensifier tube-supply kit, **$80** for a slightly blemished 40mm intensifier tube-supply kit. We also have some tubes with more blemishes and are suitable for very sensitive IR testers: **$35** for a slightly blemished 25mm intensifier tube-supply kit, **$55** for a slightly blemished 40mm intensifier tube-supply kit.

110V TRANSFORMERS
Used 240-110V transformers, about 100VA: **$15**.

HELIUM-NEON LASER BARGAIN
Large 2-3mW HeNe laser head plus a compact potted US-made laser power supply. The head plugs into the supply, and two wires are connected to 240V mains. Needs 3-6V 5mA DC to enable. Bargain: **$100**.

20A DC MOTOR SPEED CONTROLLER
A slightly modified design to the one published in the June 97 issue of SC. PCB plus all on-board components (with two power MOSFETs!), plus the flyback diode and the capacitor needed across the motor: **$18**.

27MHz TRANSMITTERS
New tested PCB assembly. Xtal locked on 26.995MHz, designed for transmitting digital information. Circuit features 5 transistors and 8 inductors – circuit provided. Power varies from 100mW to a few watts; 3-12V DC operation. Sold for parts/experimentation, should not be connected to an antenna as licensing may be required: **$7 each or 4 for $20.**

MINI TV STATION
Make your own mini TV station with this metal-cased, commercial transmitter with telescopic antenna. Dimensions 123 x 70 x 20mm, 12V operation. Includes power switch, indicator LED, RCA audio and video connectors, twin RCA-RCA lead. Our 32mm AUDIO PREAMPLIFIER kit ($8) comes (with an electret microphone) and a CCD camera will complete the station. Transmitter **$30** or **$20** when purchased with a CCD camera. REGULATED 10.4V-500mA PLUGPACK to power the whole system: **$10**.

AUDIO - VIDEO MONITOR
Compact high resolution 5-inch screen B/W audio and video monitor. Has two-way audio, built-in microphone, audio amplifier, speaker and pushbutton "talk" switch. Needs a preamplifier and microphone for remote audio monitoring (our 32mm audio preamplifier is ideal). Has two camera inputs to allow manual or auto switching (adjustable speed) between each camera. Needs 12V DC 1A (our switched mode supply is ideal), size 160 x 190 x 150mm, has audio and video outputs for connecting to a VCR etc. Monitor and 6-way mini input connector only: **$125**.

SWITCHMODE POWER SUPPLY
Compact (50 x 360 x 380mm), in a perforated metal case, 240V AC in, 12V DC/2A and 5VDC/5A out: **$17**.

CCD CAMERA
Tiny (32 x 32 x 27mm) CCD camera, 0.1 lux, IR responsive (works in total dark with IR illumination), connects to any standard video input (eg VCR) or via a modulator to aerial input: **$120**.

KITS FOR CCD CAMERA SECURITY
New INTERFACE KIT FOR TIME LAPSE RECORDING: now has relay contact outputs! Can be directly connected to a VCR or via a learning remote control: **$25** for PCB and all on-board components, used PIR to suit: **$12**.
32mm 10-LED IR ILLUMINATOR: new IR (880nm) LEDs have an output about equal to our old 42 LED IR illuminator: **$18**.
32mm AUDIO PREAMPLIFIER: an **$8** kit that produces a "line level" signal from an electret microphone, connect the output to our
UHF VIDEO TRANSMITTER: (**$30**) or **$20** when bought with the camera for a complete audio-video link.
32mm AUDIO AMPLIFIER: an LM380-based **$9** audio power amplifier which can directly drive a speaker – needs the 32mm preamplifier. WHAT IS 32mm? All boards are 32mm, so you can house these kits in a plastic 32mm joiner: cheap plumbing part.

12V VCR
IR remote controlled 12V operated VCR with record and playback function (no tuner): **$299**.

STEPPER MOTOR DRIVER KITS
Kit includes a large used 1.8° (200 step/rev) motor and used SAA1042A IC. Can be driven by an external or on-board clock; has a variable frequency clock generator. External switches (not provided) or logic levels from a computer etc determine CW or CCW rotation, half or full-step operation, operation enable/disable, clock speed. PCB and all on-board components: **$18** for kit with 1 motor, **$28** for kit with 2 motors.

DIAMOND TESTER KIT
Test if they're real! PCB, on-board components and meter movement: Available late this month: **$15**.

DC MOTOR
New, Australian-made (Preslite) 12V DC motor used to power golf buggies. Low speed, very high torque. 75mm dia, 150mm long, 7mm dia 30mm long shaft, weight 2kg. Has three 5mm tapped holes for mounting. No load current 4A, loaded current 10A. Great for experimenting with battery-powered vehicles, wind generators etc. Limited supply at a small fraction of their real value: **$36**. A suitable speed controller is the 20A DC MOTOR SPEED CONTROLLER mentioned elsewhere in this advertisement.

WOOFER STOPPER MkII
Works on dogs and most animals, ref SC Feb 96. PCB and all on-board components, transformer, electret mic & horn piezo tweeter: (K77) **$43**. Extra tweeters (drives 4): **$7 each**. Approved 12V plugpack (PP6) $14. UHF REMOTE TRIGGER single channel Rx and Tx: (K77T) **$40**.

MASTHEAD AMPLIFIER KIT
Our famous MAR-6 based masthead amplifier. Two-section PCB (so power supply section can be indoors) and components kit (KO3) **$15**. Suitable plugpack (PP2): **$6.** Weatherproof box: (HB4) **$2.50**. Box for power supply: (HB1) **$2.50**. Rabbit-ears antenna (RF2) **$7**. (MAR-6 available separately).

USED ICs
Guaranteed, previously socketed ICs, never soldered to. Data not supplied.
- 146818P: real time clock: **$4**
- R65C21P2: 6821 PIA: **$2**
- P8031: 8-bit CPU: **$2**
- 6803: 8-bit CPU: **$4**
- HD680G: 8-bit CPU: **$4**
- R6545: CRT controller: **$2**
- HD6845: CRT controller: **$2**
- HD6821: interface adaptor: $1
- AY3-1015: 8-bit UART: **$4**
- 27C64: EPROMS: **$2**
- 27C256: EPROMS: **$3**

USED PIR MOVEMENT DETECTOR
Commercial quality 10-15m range, used but tested and guaranteed, have open collector transistor (BD139) output and a tamper switch, 12V operation, circuit provided: **$10**.

650nm VISIBLE LASER POINTER KIT
YES, NEW 650nm kit!!! Very bright! Complete laser pointer that works from 3-4V DC. Includes 650nm/5mW laser diode, new handheld case 125 x 39 x 25mm, adjustable collimator lens, PCB battery holder: **$35**.

DISCO LASER LIGHT SHOW PACK
The above 5mW/650nm kit plus our AUTOMATIC LASER LIGHT SHOW: **$99**.

650nm LASER POINTER SPECIAL
Light weight (2 x AAA) pen-sized pointer with 650nm laser diode!! Very bright!: **$55**.

650nm LASER MODULE
Our new module is fitted with a 650nm laser diode!! Very small: **$50**.

12V - 2.5W SOLAR PANEL KIT
US amorphous glass solar panels with backing glass: (S12) **$22 each, 4 for $70**.

WIRELESS IR EXTENDER
Converts the output of any IR remote control to UHF. Self-contained transmitter attaches to IR remote. Kit includes two PCBs, all components, 2 plastic boxes, Velcro strap: (K89) **$39**. (9V battery not included). Plugpack for Rx (PP10): **$11**.

SUPER BRIGHT BLUE LEDS
BY FAR THE BRIGHTEST BLUE EVER OFFERED, super bright at 400mCd: **$1.50 each or 10 for $10**.
5mm LEDS AT SUPER PRICES
1Cd red: **10 for $4**.
300mCd green: **$1.10 each or 10 for $7** (make white light by mixing the outputs of red, green and blue).
3Cd red: **$1.10 each or 10 for $7**.
3Cd yellow (small torch!) also available in 3mm: **10 for $9**.
Super bright flashing LEDs: **$1.50 each or 10 for $10**.
BATTERY BONUS Twin AAA battery holder and two AAA batteries for **60c** with any LED purchase: flash a high intensity LED for a month! Limit of 3 per customer.

COMPUTER CONTROLLED STEPPER MOTOR DRIVER KIT
PCB and components kit plus information and PC software: (K21) **$35**. Kit plus 2 stepper motors (small M17 or large M35) (K21M): **$48**.

CAR ALARM KIT WITH THE LOT
This kit can armed/disarmed by a hidden switch, or by a UHF REMOTE CONTROL which also has provision for operating a CENTRAL LOCKING KIT. The CAR ALARM kit includes a PCB, all on-board components and ultrasonic transducers. It features ultrasonic movement detection, provision for bonnet-boot protection (pin switches not supplied), vibration detector and a flashing high intensity LED. Four LEDs make for easy diagnostics and setting up: **$35**.

CENTRAL LOCKING
This four-door central locking kit is a commercial product that includes 2 master and 2 slave actuators, wiring loom, control unit, necessary hardware and instructions: **$60**.
The UHF REMOTE CONTROL KIT has a switched relay output for operating an alarm etc, an indicator output for driving a buzzer etc, and logic level outputs for operating the CENTRAL LOCKING KIT. Comes with a ready-made transmitter with two pushbuttons (lock, relay on - unlock, relay off), and a receiver PCB and all on-board components. 5 LEDs make for easy tuning and diagnostics: **$35**. SIREN KIT includes speaker **$12**.

NICAD CHARGER & DISCHARGER
Professional, fully assembled and tested fast NICAD battery charger and discharger PCB assembly. Switchmode circuit, surfaced mounted on a double-sided PCB with gold-plated through holes and pads. Has 6 ICs, 3 indicator LEDs, 3 power MOSFETs, a toroidal inductor and many other components: over 100 in total. Nominal unregulated input 13.7V DC, 900mA charge current. Appears to use voltage slope detection for charge terminating, also has a timer (4060) to terminate the charge. We supply a thermistor for temperature sensing. Probably for fast-charging 7.2V AA nicads. Three trimpots allow some adjustment. Basic information provided, plugpack not included. Incredible pricing: **$9 each or 3 for $21**.

MOVING MESSAGE DISPLAY PCB
Used, complete PCB assembly with bright dot matrix red LED displays and driver. Circuitry includes twenty 74HC164 ICs. Has 20 displays each with 35 LEDs (700 LEDs!). Displays are in a single line to form a continuous display. Display size is 280 x 18mm, PCB 330 x 75mm. Needs external 5V supply. Includes a simple program on disk and instructions to make the display scroll number "1" through all displays, via a computer parallel port. Limited quantity: **$40**.

MOTOR AND PUMP
New, compact plastic pump with a 240V AC 50Hz 0.8A 91W 2650 RPM induction motor attached. Probably a washing machine part. Very quiet operation, made in Japan, overall dimensions 160 x 90 x 90mm, weight 1.2kg, inlet 25mm diameter, outlet 20mm diameter. Other end of motor has 20mm long 4mm diameter shaft. Motor can be rewound for lower AC voltage and/or reduced power operation without disassembling the unit. We calculated 5.5 turns per volt: **$19**.

SOLAR REGULATOR
Ref: EA Nov/Dec 94 (intelligent battery charger). Designed to efficiently charge 12-24V batteries from solar panels, but can also be used with simple car battery chargers (like Arlec 4A chargers) to prevent overcharging. Regulates by sensing battery voltage. Has voltage reference IC. Suitable for currents up to 16A, and can be easily modified for higher currents (by paralleling MOSFETs and Shottky diodes). Extremely high efficiency due to the very efficient MOSFET switch and Shottky isolation diode. Has negligible standby current consumption. The PCB is now smaller and we offer a 7.5A or 15A kit. The 7.5A kit has one Shottky diode and the 15A kit has two: **$26/$29** (K09).

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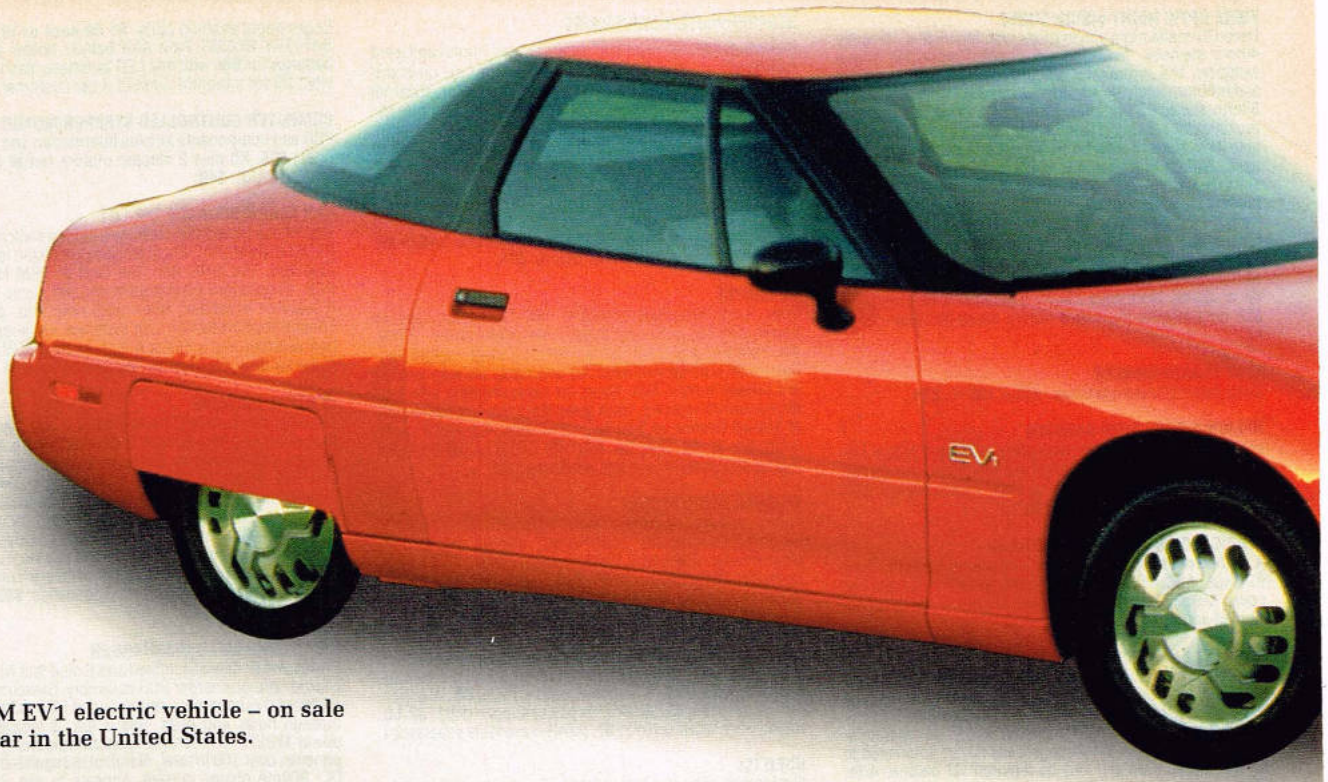


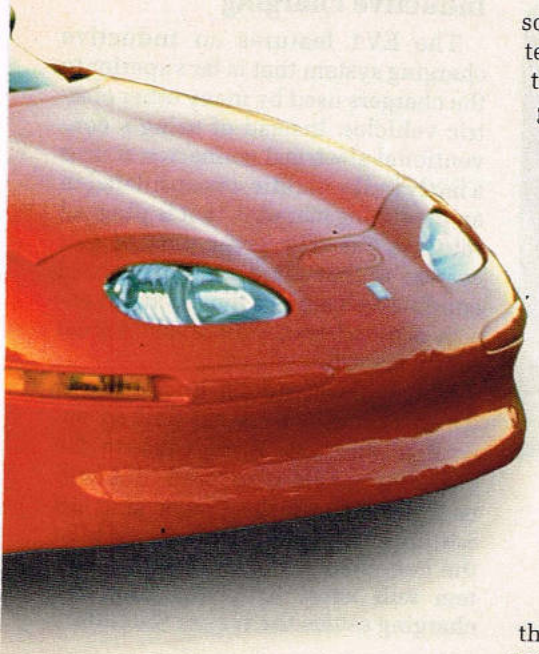
The GM EV1 electric vehicle – on sale this year in the United States.

Electric Vehi

Where are they now?

During the early 1990s there was great media publicity concerning electric cars. They were to be the solution to the world's pollution problems, with some of the more optimistic industry experts predicting that we would be driving them before the turn of the century. So where are they now?

By SAMMY ISREB



cles

Several of the world's leading car manufacturers have been developing electric vehicle technology during the past few decades, with Ford and General Motors leading the way. Ford's latest electric vehicle, the 1998 Ford Ranger EV, is due for release in the near future, GM has the EV1 passenger car and Toyota has an electric version of the RAV4.

The Ford Ranger EV was designed using data obtained from the Ford Ecostar test program, which began in 1993 and involved 103 Ecostar two-passenger EV delivery vans, operating throughout the US, Canada and some of Europe.

Powered by a sodium-sulphur battery, the Ecostar fleet has covered over 1,000,000 kilometres, the greatest of any EV fleet so far. Much of the new technology to be incorporated in future electric vehicles has been tested in the Ecostar. This includes:

(1). Traction Battery: An advanced sodium sulphur battery operates at a temperature of over 200°C and features an energy density three times greater than conventional lead acid batteries.

(2). PEC (Power Electronics Centre): The Ford Ecostar contains an advanced power control system, incorporating an inverter to produce AC power for the motor.

(3). DDLM (Diagnostic Data Logger Module): Records every aspect of the vehicle's performance, allowing for later engineering analysis.

(4). Solar Energy: Using solar panels mounted above the windshield, accessories such as fans can be powered from the sun, saving on air-conditioning and thus the battery.

(5). Multiplexing: Because of the complexity of the different electronics modules in the Ecostar, conventional wiring would require 200 separate circuits. Multiplexing allows the eight different modules to communicate over a single pair of wires.

To be released in the United States next year, the 1998 Ford EV Ranger shares the body of the petrol-driven Ranger but that is where the similarities end. This pickup truck features 4-wheel ABS brakes, dual airbags, climate control, power steering and regenerative braking. The Ranger uses a 90 horsepower 3-phase AC induction motor with no gearbox and it is rear-wheel driven. An inverter works with the 312V, 23kW sealed lead-acid battery system to convert the high voltage DC to 3-phase AC.

Low rolling resistance tyres and lightweight aluminium wheels, together with the regenerative braking, give the Ford Ranger a range of about 90 kilometres, with an electronically-governed top speed of 120km/h.

Both the Ecostar and the Ranger use a conductive charging system. This system automatically checks for a proper electrical connection to the vehicle, checks that the charging station is ready to charge the battery, confirms the battery type and charge station capacity, and ensures that all safety systems are working before proceeding to charge the vehicle. A full charge is achieved in 4-6 hours, depending on the state of battery discharge.

GM's EV1 electric vehicle

Set to challenge Ford in the EV market place is General Motors, with their new electric vehicle, inventively named the EV1. It has recently gone on sale in America and sells for about $US35,000.

The EV1 is a front wheel driven aluminium-bodied 2-door passenger coupe. The designers of the EV1 have tried to boost the range of the vehicle, not by using special batteries but by taking other measures, such as lowering body weight and drag.

In fact, the EV1 has a drag coefficient of 0.19, compared to between 0.30 and 0.40 for a standard production car. This was achieved by taking extraordinary steps such as closing off the underside of the car, covering the rear wheels with skirts, using low rolling resistance tyres, and even building the radio antenna into the roof rather than having a standard extendable antenna.

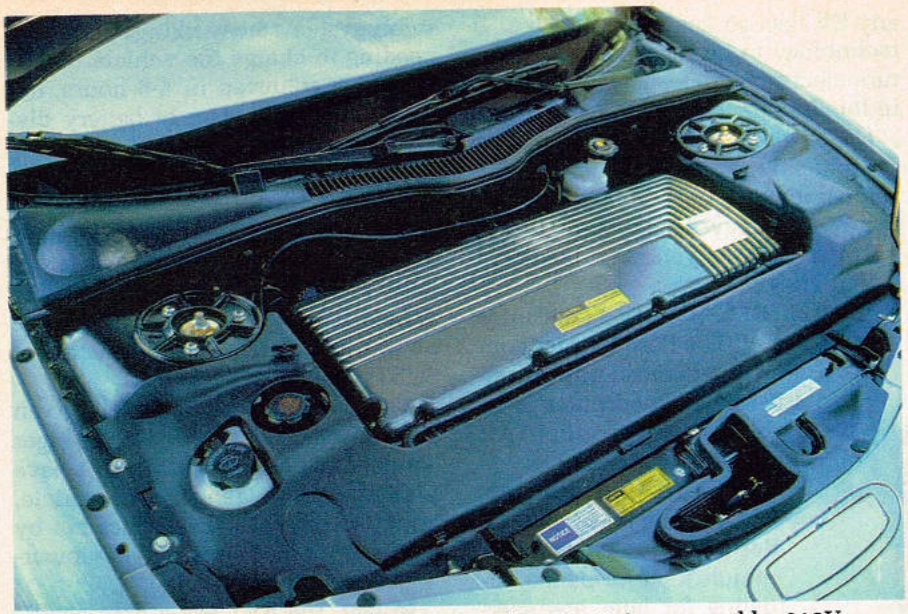
A 137-horsepower 3-phase AC-motor drives the EV1. This motor is water cooled and revs from 0 - 13,500 rpm. This wide rpm range, coupled with a broad torque curve, eliminates the need for a transmission.

Acceleration is quite good, with the motor propelling the EV1 from 0 to 100km/h in around nine seconds.

Powering the EV1 is a 312V battery pack, made up of 26 maintenance-free, valve-regulated, lead-acid modules. Environmentalists will be able to drive the EV1 knowing that the batteries are 98% recyclable. Because safety is a crucial factor in any electric vehicle, the batteries are of sealed construction in which all the liquid acid is encapsulated in a diaper-like material between the individual lead plates. This results in a battery so safe that a hole could be made in the case and no liquid would flow out.

Clever electronics

At the heart of the vehicle's electronics system is the inverter. This uses six Insulated Gate Bipolar Transistors (IGBTs) which perform the high power switching needed to convert the 312V DC from the battery system to AC for the motor. These IGBTs can



A 137 horsepower 3-phase AC motor drives the EV1. It is powered by 312V battery pack, made up of 26 maintenance-free lead-acid modules. The motor is water-cooled and revs from 0 - 13,500 rpm which eliminates the need for a transmission.

handle up to 600V at 750A, making them very rugged indeed.

An inventive electronic circuit controls the drive and braking system. Known as the Galileo Braking System, it uses software to constantly monitor the driving conditions and selects ABS braking or traction control when appropriate.

This electronic system also monitors tyre pressure and inflates the tyres when necessary. In addition, a regenerative braking system is used to charge the battery during braking and this significantly boosts the range of the vehicle.

Another major design feature of the EV1 is the inclusion of a heat pump. This works as a heat exchanger to move hot or cool air inside and outside the car. The pump takes coolant from the motor and inverter electronics and passes it through the car in order to heat it. Cooling is achieved through a CFC-free energy efficient air-conditioning system.

Inductive charging

The EV1 features an inductive charging system that is far superior to the chargers used by many other electric vehicles. Instead of using a conventional electrical connector, it uses a fairly bulky paddle, encapsulated in an insulating material, that is plugged into the car. The great plus of this system is that there are no exposed conductive parts, as the electrical energy is transferred inductively; a great safety feature.

The paddle can be immersed in water, run over by a car and so on, without any risk. If the cable to the charging paddle is severed, this will be detected and the power shut off within a few microseconds. Whilst the complexity of this charging system will boost its price, inductive charging seems the way of the future.

Toyota's RAV4

Set to rival both Ford and GM, Toyota plans to release an electric version of its RAV4 to fleet buyers in the United States in early 1998. The EV RAV4 will basically be a reworked petrol RAV4 featuring a nickel metal hydride battery.

With a top speed of 125km/h and a range of 190km, the RAV4 is competitive. However, the RAV4 will not become economically viable for the mass market in the near future, due to the high price of the nickel metal hydride batteries and the fact that (unlike the EV1) large scale production is not envisaged for the moment. Over the next few years, only 320 EV RAV4s will be produced for fleet trials.

Although this article has described the market-leading electric vehicles that have emerged in the past few years, there are quite a few others from smaller car manufacturers that have not been mentioned. And although the EV1, Ecostar and Ranger are set for large-scale production, their sales are likely to be limited to the US and parts of Europe.

As yet, no electric vehicle is widely available in Australia and none is likely to be for some time. It will probably be the better part of a decade before we see serious EV trials in Australia. **SC**

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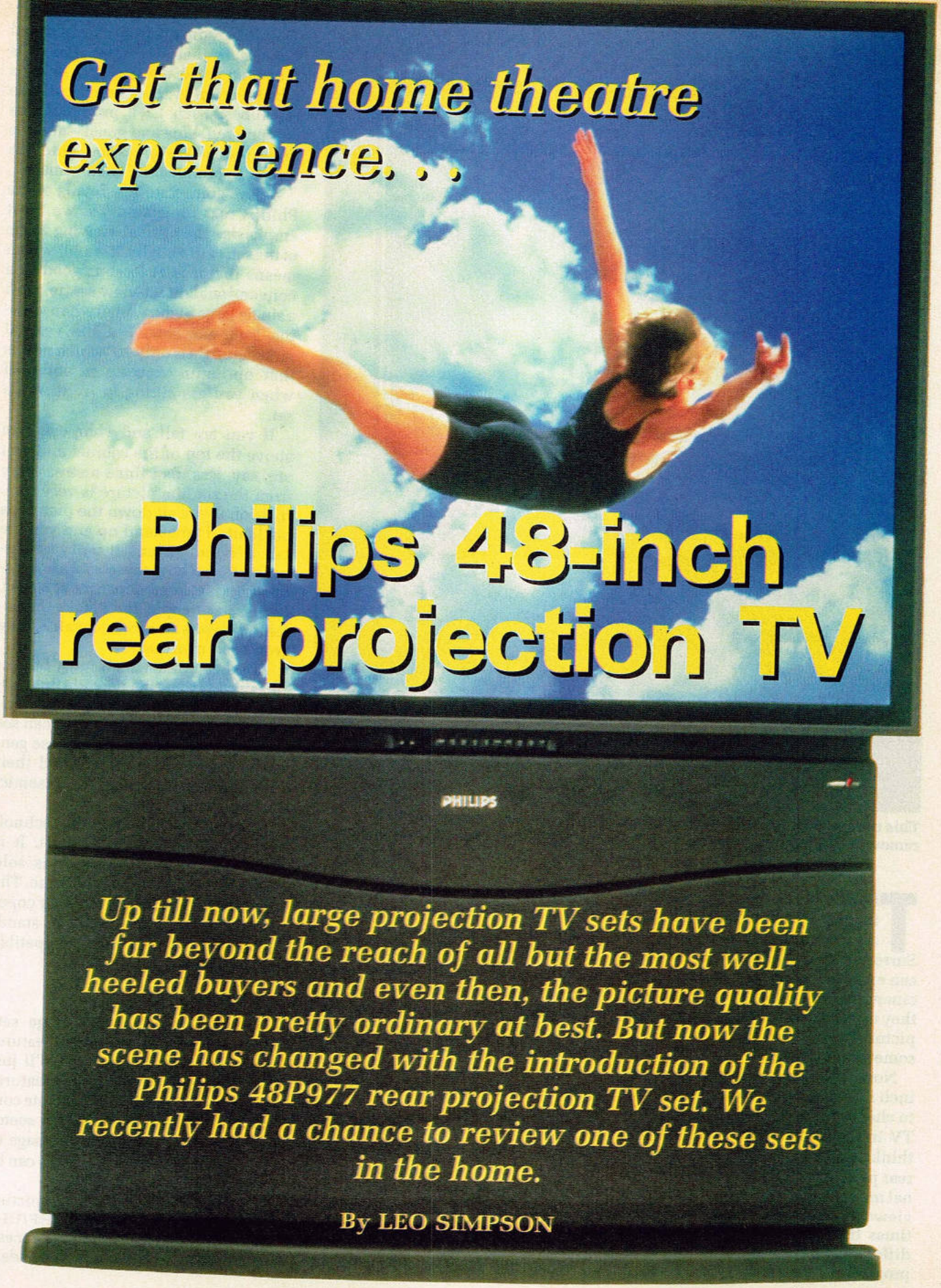
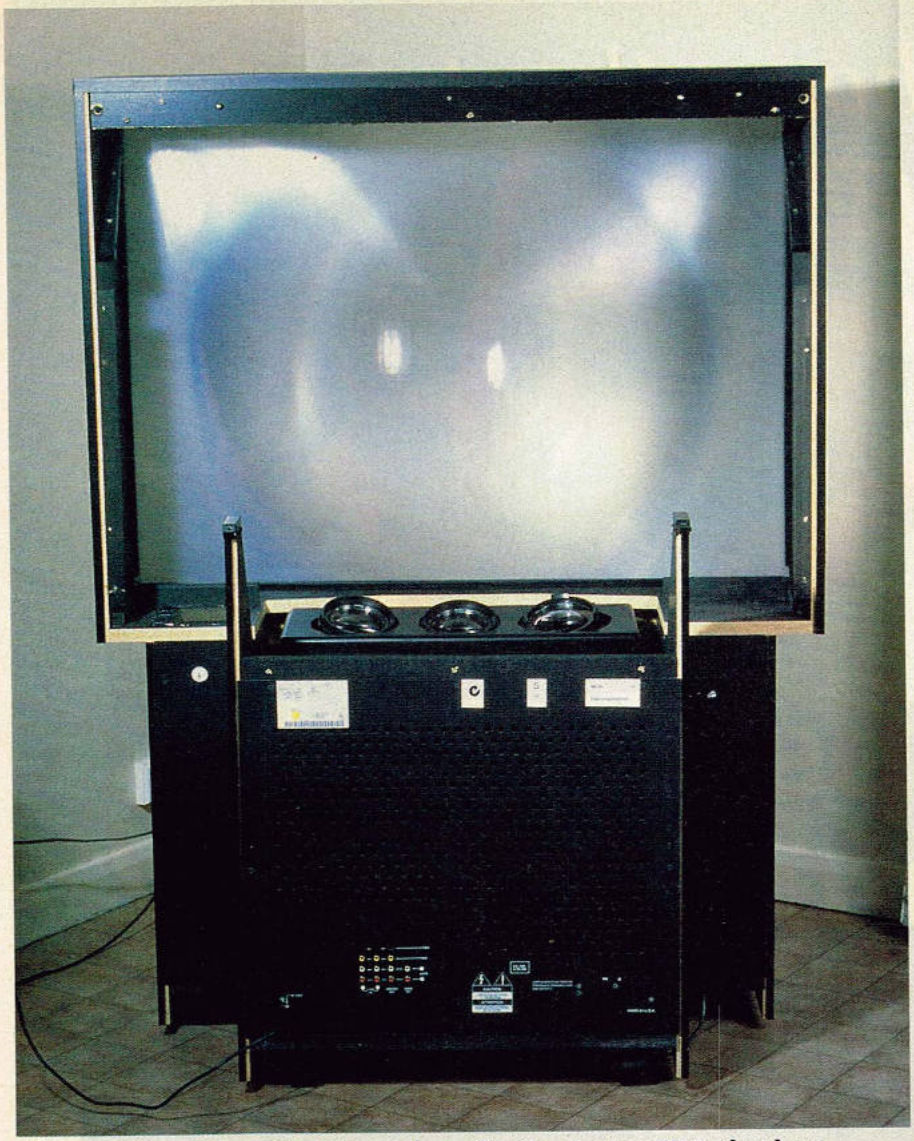


Up till now, large projection TV sets have been far beyond the reach of all but the most well-heeled buyers and even then, the picture quality has been pretty ordinary at best. But now the scene has changed with the introduction of the Philips 48P977 rear projection TV set. We recently had a chance to review one of these sets in the home.

By LEO SIMPSON



This rear view of the set has been taken after the sloping mirror has been removed. The aspheric Fresnel lens at the back of the screen can be clearly seen.

THESE DAYS, there is enormous interest in home cinema. People are spending big dollars on Dolby Surround sound systems so that they can experience the "big sound" of the cinema in their own home. Trouble is, they usually don't experience the "big picture" as well so the total effect is somewhat lacking.

Now Philips have released their 48-inch rear projection TV and this is set to change the way people think about TV in the home. While most people think that a 68cm TV is a large set, this rear projection TV has a screen diagonal measurement of 122cm, giving it a viewable screen area more than three times the size of the 68cm set. The difference in image size, with the projection TV set in a typical room, is little short of staggering. This is TV with real "big picture" impact.

Not only is the screen large but the overall set is really dominating – it is visually as big as the largest 2-door refrigerator. Measurements will give some idea of its size but they don't prepare you for its impact. It stands 1407mm high, 1041mm wide and 573mm deep. And it weighs all of 86kg, so it is fortunate that it rolls easily on its castors.

Actually, it is not all that deep at 573mm. That is not as deep as some conventional 68cm or 63cm sets so it really does not take up a lot of floor space. But even in a large room, it is hard to ignore its presence, even if no picture is showing.

Where the Philips rear projection TV differs radically from conventional TV sets is that its screen image is projected on to the rear of a flexible plastic screen by three 7-inch cathode ray tubes. Each CRT produces one colour – red, blue and green – and the three beams are projected onto the screen to produce the colour image.

Before going into the details of the Philips rear projection TV, we must emphasise the critical viewing angle of the set. Horizontally, it is 160° which means that it is at least as good as a conventional direct-view set (ie, with a single large picture tube) when viewing from the side. But the vertical viewing angle is only 16° which means that optimum viewing is obtained when you are sitting in front of the set.

If you are tall and your eyes are above the top of the cabinet and you are, say, less than three metres away from the set, the picture is very dim. In brief, if you sit down the picture is brilliant; if you stand up and you are tall, it's a non-event. It will be interesting to see how these sets are demonstrated in large department stores. If the sales-people don't make the potential buyers sit down to watch, they won't sell many sets!

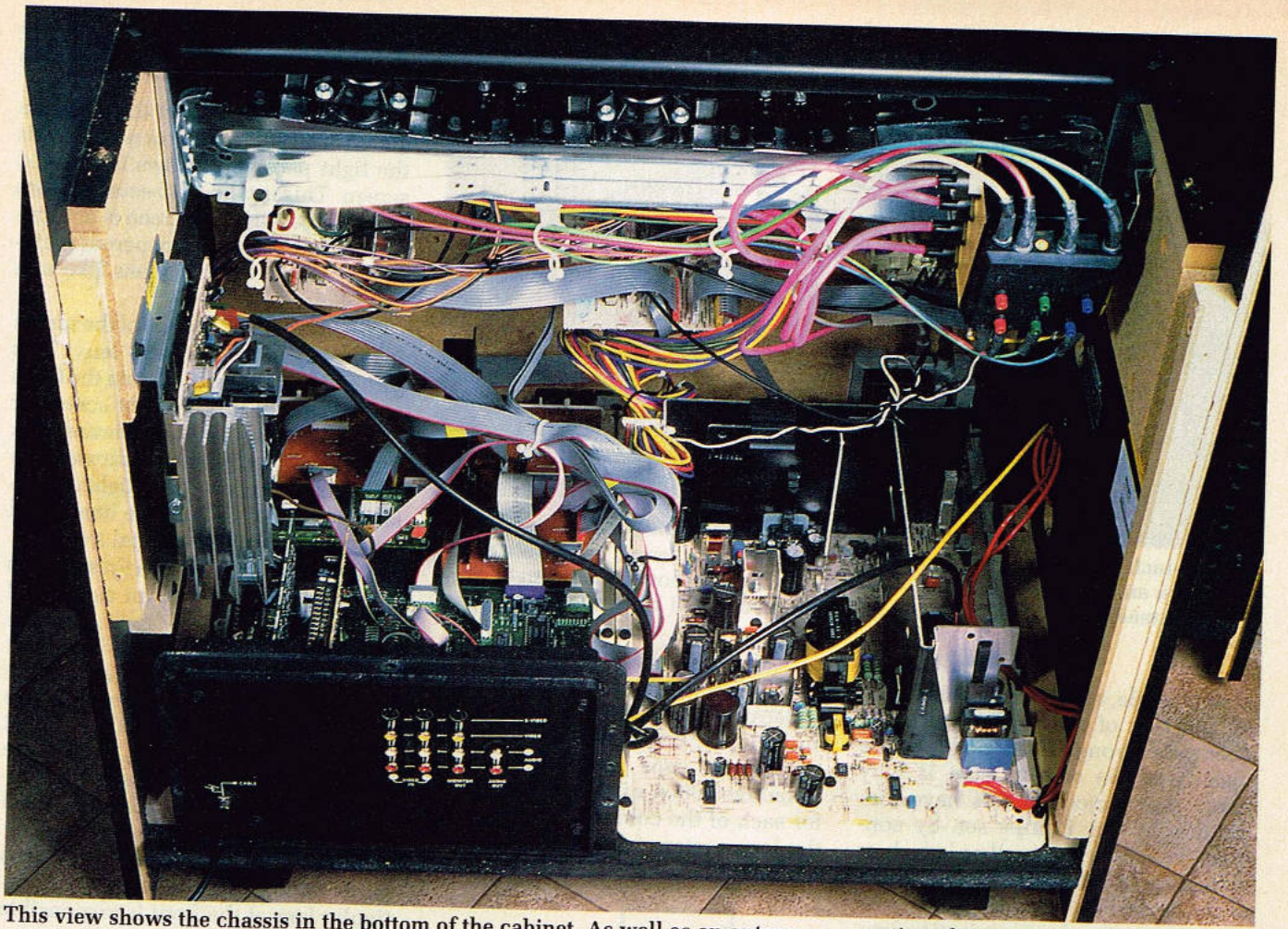
Another point which must be emphasised is that this new Philips projection set is a lot better than the average rear projection TV set you can see in many clubs and hotels. These generally give a poor picture and their only virtue is a large, albeit anaemic-looking, screen image.

Now let's have look at the technology of the Philips 48P977 set. It is made in the USA where it is sold under the Magnavox brand name. The small signal processing circuitry copes with NTSC, SECAM and PAL standard signals so it is fully compatible with Australia.

Features

As with most modern large sets these days, the list of control features seems to go on forever so we'll just cover the main points. All the features are accessible via the large remote control and pressing every button seems to bring up an on-screen message or menu. The on-screen messages can be in English, Chinese or Malay.

Naturally, it has picture-in-picture (PIP) which involves two VHF/UHF tuners and two sets of video processing circuitry. Teletext is a standard



This view shows the chassis in the bottom of the cabinet. As well as an antenna connection, the set can be connected to two VCRs or a variety of video sources such as a laser disc player or video game machine.

feature too, as is multi-standard reception (ie, PAL, NTSC & SECAM), as mentioned above. You can have as many as 100 preset channels, although no-one is ever likely to approach that limit in Australia.

Stereo sound is incorporated but not Dolby Surround decoding. There is a feature called "Incredible Sound" but it is essentially an enhanced stereo mode with apparently wider channel dispersion. Interestingly, on sports programs it brought up the audience noises to the point where they were quite intrusive.

Other features are Dynamic Noise Reduction (DNR), Child Lock, Timer, Message, Smart Picture and Incredible Picture. DNR is supposed to reduce noise (snow) in the picture but its effect was never readily apparent. Child Lock does nothing of the sort (sadly) but does prevent certain channels from being selected from the buttons on the front of the set. However, if the said child has access to the remote control (and they always do, don't they?), then anything can be watched.

Timer is a facility to switch the TV to another channel at a specific time. You can set it to switch to two separate programs at different times. It could be handy if you are prone to forget to watch a particular program.

Message is a facility to display a message on the screen. You use the remote control to create and store the message which can then be run continuously while the set is on. One message which comes to mind is "Do your homework"!

Incredible Picture is anything but. Pressing the relevant button brings about a minor change to the contrast, to the point where it is probably closer to the optimum setting. I was underwhelmed, just as I was with "Incredible Sound".

Smart Picture is accessed by one button on the remote control and repeated pressings brings up settings called Rich, Natural, Soft, Personal and Game. In practice, unless you carefully tweak your Personal settings (brightness, contrast, colour and white point), all will be wrong. "Rich" is too dark with too much colour, "Soft" is just that and "Natural" is fairly close to the mark but the contrast setting means that the dark greys are pushed into the black. "Game" turns up the contrast so that you get a very bright picture and the sound is modified too, with bass boost.

Projection system

Most readers would be aware of the general principle of projection TV whereby separate red, green and blue cathode ray tubes are used to project a colour image onto a screen. The CRTs are typically 7-inch diagonal units and they are driven quite hard to obtain sufficient brightness.

For rear projection sets there is an additional problem in that because the CRT beams are projected at an

Three 7-inch CRTs are liquid coupled to complex plastic lenses to provide the red, green and blue beams. The blue lens has a slightly shorter focal length (77cm instead of 78cm) than the red and green lenses and has a slightly larger aperture.

oblique angle, a lot of the light bounces off the rear of the screen and what does pass through is cut down by the opacity of the screen. That is why many rear projection sets have dim picture. In this Philips set, by contrast, the screen is actually a large lens system and it results in a picture which is claimed to be three times brighter than conventional rear projection sets.

Fig.1 shows the general arrangement of the CRTs and screen in the Philips set. The beams are bounced off a mirror and then onto the rear of the screen. The light beams are bent through an angle of 72° which enables the cabinet to be quite shallow.

The CRTs each have a curved faceplate which leads to better corner illumination than is possible with a flat faceplate. The curved faceplate is coupled to a complex multi-element plastic lens system by a fluid consisting of an ethylene glycol mixture which has a refractive index very similar to that of the CRT glass and that of the lens system.

The fluid serves two purposes. First, it acts as a coolant, allowing the CRTs to be driven much harder for a brighter picture. Second, by occupying the space between the tube faceplate and lens system, the fluid virtually eliminates any reflective surfaces which could reduce image contrast. It also eliminates the possibility of dust being deposited on the tube faceplate which would otherwise be certain to occur. The CRTs, by the way, are operated with an EHT of 30kV.

Because, the CRTs produce different colours, they have different lens systems, to cope with the different refractive index of the lens material for each of the colours. Hence, while the lens system for red and green is same, the lens for the blue beam has a slightly shorter focal length and a slightly larger aperture.

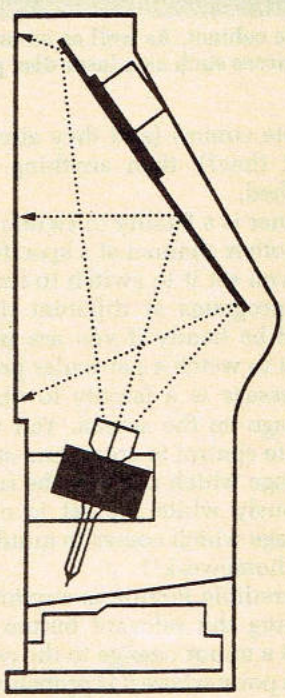


Fig.1: the CRTs in the Philips rear projection set are angled towards the back of the cabinet and the mirror deflects the light beams through an angle of 72°.

The three beams from the CRTs are aimed at an angled mirror which folds the light path and throws it onto the screen. This is where it becomes quite complex because the screen is not simply a sheet of semi-transparent material which is what it looks like at a casual glance.

Instead, the rear surface of the screen is actually a large fresnel lens. This gathers the light emitted from the CRTs and focuses it on the front screen or "lenticular lens" as it is referred to in the Philips technical literature. The lenticular lens provides a light dispersion pattern of 160° on the horizontal axis and 16° on the vertical axis.

To accomplish this, the Fresnel lens is optically ground in an aspherical pattern to project the light out in a horizontal beam, more or less. But first the light must pass through the lenticular lens at the front of the screen. This consists of fine vertical grooves with a pitch of 0.78mm. The surface between the grooves has a parabolic convex cross-section to spread the light out in the horizontal axis.

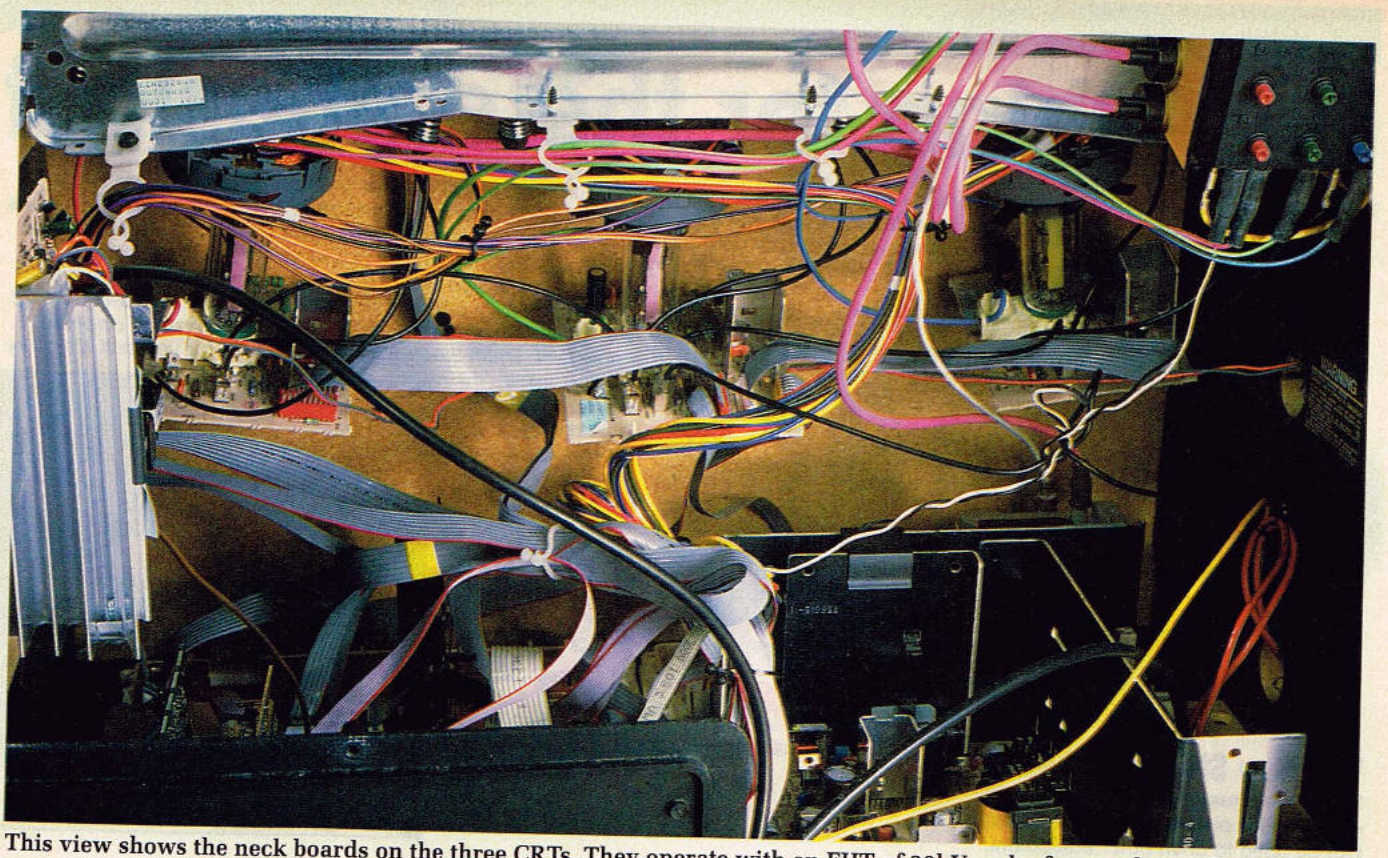
The combination of the Fresnel lens at the back of the screen and the lenticular lens at the front is responsible for a very much brighter screen image than was possible in the past with rear projection sets.

TV circuitry

Apart from the fact that this is a multi-standard projection set, the electronics is not much different from a normal TV set. Of course, there are three CRTs and each has its own deflection yoke, video neck board and EHT connection. But there are no purity magnets. Convergence is much more complex than on conventional sets but the adjustment process is more straightforward because of the inclusion of digital convergence circuitry. The set also generates its own white cross symbol on the screen which can be used (by the consumer or a technician) to adjust the convergence at any time.

Watching the set

We talked about viewing angle towards the start of this article and how the large image has a lot of impact but that does not really tell the whole story. With this set, images of people



This view shows the neck boards on the three CRTs. They operate with an EHT of 30kV and a focus voltage of 15kV.

are often so much larger than life-size, just as they are in your local cinema (although not quite that large). You become very aware of blemishes on the faces of TV personalities where previously, watching a normal TV set, you were blissfully unaware of these defects.

By the same token, signal quality becomes critical. Where you might have tolerated a noisy, "ghosty" signal on a small conventional set it becomes unwatchable on the projection set. Even quite good signals on normal sets are mercilessly revealed to have defects. Perhaps there might be low-level herringbone interference, the faint vertical lines due to sync pulse ghosts, rapid flutter due to aircraft passing overhead or the often very poor quality picture from a VCR running a rental videotape.

On our review sample, we also had an interference band down the left-hand side of the screen on the UHF SBS channel which was completely invisible on a 63cm set fed from the same outlet and we were unable to track where it was coming from.

On the other hand, if you have a first class TV signal, a video signal from an S-video or digital camcorder or laser disc player, the picture is very pleasant.

Picture brightness is still not quite as good as from the latest 68cm high contrast picture tubes but is still quite satisfactory, even in a brightly lit room. Most people who saw the review set were impressed with the overall picture brightness.

Critical viewers will note that the picture is not as sharp as on a 68cm set and that must be expected. After all, the same program information is being blown up to produce an image more than three times larger than on a normal set. If you view from about four metres or further away, the picture sharpness is entirely satisfactory. You need a big room for a big set; it's that simple.

All programs have greater impact and visual interest and this applies particularly to sporting events. You find yourself looking at particular points of interest on the screen rather than the screen as a whole.

And while movies shown in "letter box" format have always tended to be less satisfying on conventional TVs, because of the black bands at top and bottom of the screen, this does not apply to this Philips set. Because the screen size is so large to begin with, the "letter box" picture is satisfying.

In conclusion, if you want a big picture in your home cinema setup, it would be hard to go past the Philips 48-inch rear projection set.

How much is it?

Well, what does it cost? In the overall scheme of things, not a lot. When you consider how much money many people are already spending on surround sound setups, the cost of this set is not huge. Its recommended retail price is $5999.00. It comes with a one-year parts and labour warranty. It is available from Myer/Grace Bros, David Jones, Brashs, Chandlers, Harvey Norman, Vox, selected Retravision and Betta stores and selected specialists Australia-wide.

As part of the deal, Philips is offering free delivery and installation into consumers' homes in most areas. A trained Philips technician will connect the projection TV to all existing equipment, provide a product demonstration and remove the packaging material for recycling.

For more information, contact Philips Customer Information centre by phoning 131 391. **SC**

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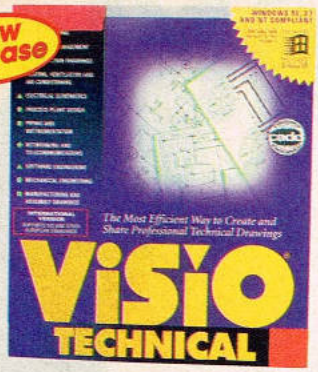

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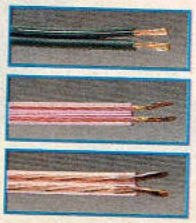

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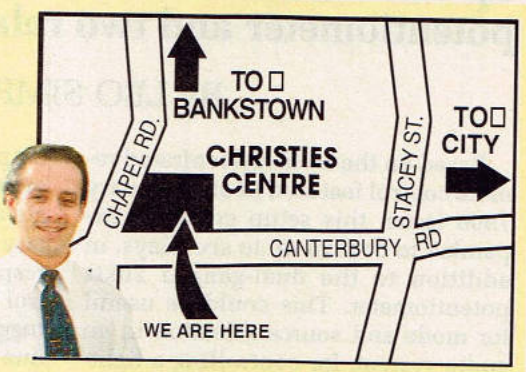

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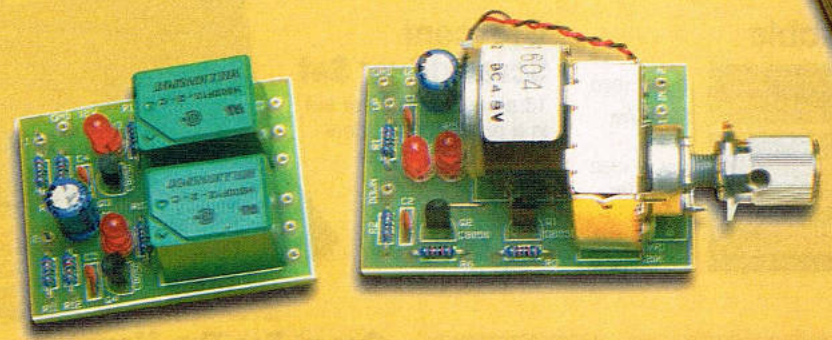


Build this general purpose unit for your stereo system or model railway

Want an IR remote control setup for your stereo amplifier, lighting system, model railway or any other system? This cheap set-up offers a motor-driven dual-ganged 20kΩ potentiometer and two relays.

By LEO SIMPSON

Based on the 8-channel infrared remote control featured in our February 1996 issue, this setup could be expanded to control up to six relays, in addition to the dual-ganged 20kΩ potentiometer. This could be useful for mode and source selection in an audio system, for controlling a lighting system or possibly for selecting various functions in a model railway layout.

As presented in the February 1996 issue, the 8-channel remote control was just a bare-bones transmitter and receiver board. Of the eight decoded outputs on the receiver board, six were momentary outputs and two were toggle or latching outputs. The momentary outputs were high only while the respective buttons on the remote control were pushed, while the latched or toggle outputs would latch high for one press of their respective buttons and then latch low for the next press; ie, they provided "toggle" operation.

Now while this system was attractive for many users, quite a few readers wanted more functions, which is why we are presenting this enhanced system. The enhanced system has a modified transmitter board and adds a PC board which controls the motorised potentiometer and two relays. The board can be split so that the relay section is separate from the potentiometer section.

The motorised potentiometer is similar to those used for the volume control of millions of remote controlled home sound systems. It consists of the dual ganged potentiometer itself, a 4.5V DC motor and a gear and clutch system. The clutch lets the motor keep running even when the potentiometer has reach the end of its travel and so no cutout switches are required.

Note that you could run more than one motorised pot from the infrared receiver if you wanted to. We'll briefly mention the details later. But first, as they say on TV news programs, let's have a look at the transmitter and receiver sections.

The transmitter handpiece measures 155 x 35 x 16mm and is branded Magnavox. The seven buttons are labelled

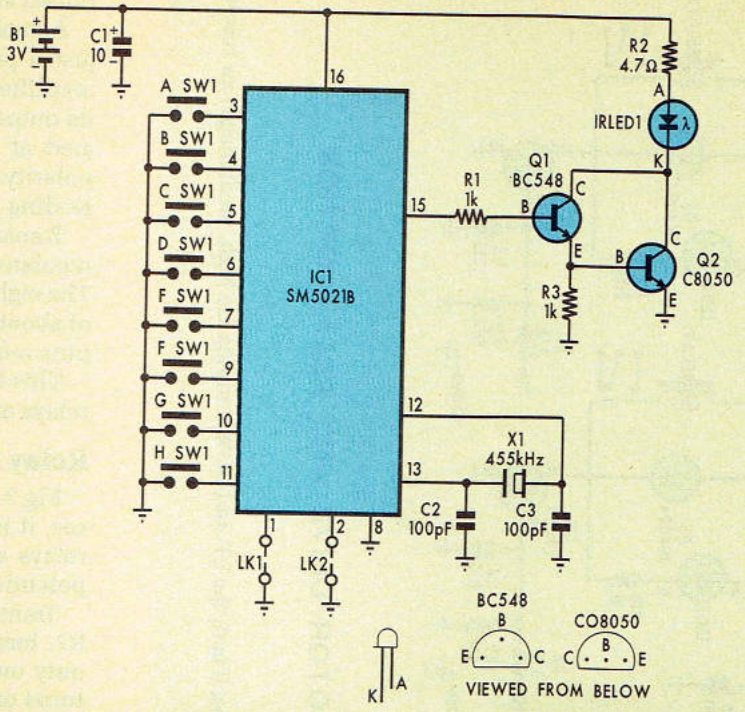
Tuner, CD, Track, Standby, Stop, Play and Volume. The last button is elongated and can be pressed at either end to make the Volume setting go up or down. When the Tuner or CD button is pressed, it operates one of the latched outputs on the receiver board. To unlatch the respective output, you need to press the same button. We use both latched outputs to drive relays so to operate a relay, you press the Tuner or CD button and to de-energise the relay you press the same button again.

The remaining buttons control momentary outputs on the receiver board; they each go high, for as long as the respective button is pressed.

The transmitter circuit is shown in Fig.1 and consists simply of an SM-5021B encoder (IC1) together with two transistors which drive the infrared light emitting diode, IRLED1. IC1 uses a 455kHz ceramic resonator as the oscillator and this is divided internally to give a 38kHz carrier frequency which is gated on and off by the data, according to which button is pressed.

The 38kHz data pulse train appears at pin 15 and is amplified by the Darlington-connected transistors Q1 & Q2 to drive IRLED1. When buttons are not being pressed, pin 15 is low so no current passes through the transistors and the chip itself has negligible current drain.

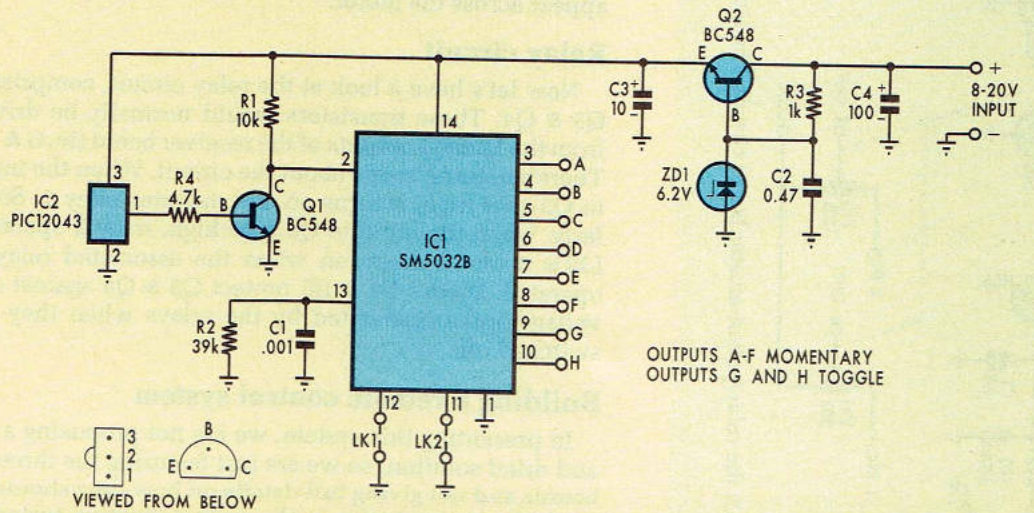
There are two links marked on the circuit: LK1 & LK2. These are coding links and should normally be left open circuit. The only reason for installing these links would be if you were using more than one of these remotes in the same location. In that case, you might, for example, install LK1 in one transmitter and LK2, in another transmitter. If you do this, you must ensure that the respective receiver boards have the same links installed.



8 CHANNEL IR TRANSMITTER

Fig.1: the 8-channel infrared transmitter. We suggest that the coding links LK1 & LK2 be omitted unless you are going to use two remotes in the one area.

Speaking of the infrared receiver board, the circuit is shown below in Fig.2. It is almost as simple as the transmitter. As can be seen, it consists of an infrared receiver diode and preamplifier (IC2) feeding an SM-5032B decoder, IC1. This has eight outputs, six of which are high while the relevant transmitter button is



8 CHANNEL IR RECEIVER

Fig.2: the 8-channel receiver circuit. Outputs G & H are latching while the other six are high only while the relevant transmitter button is pressed.

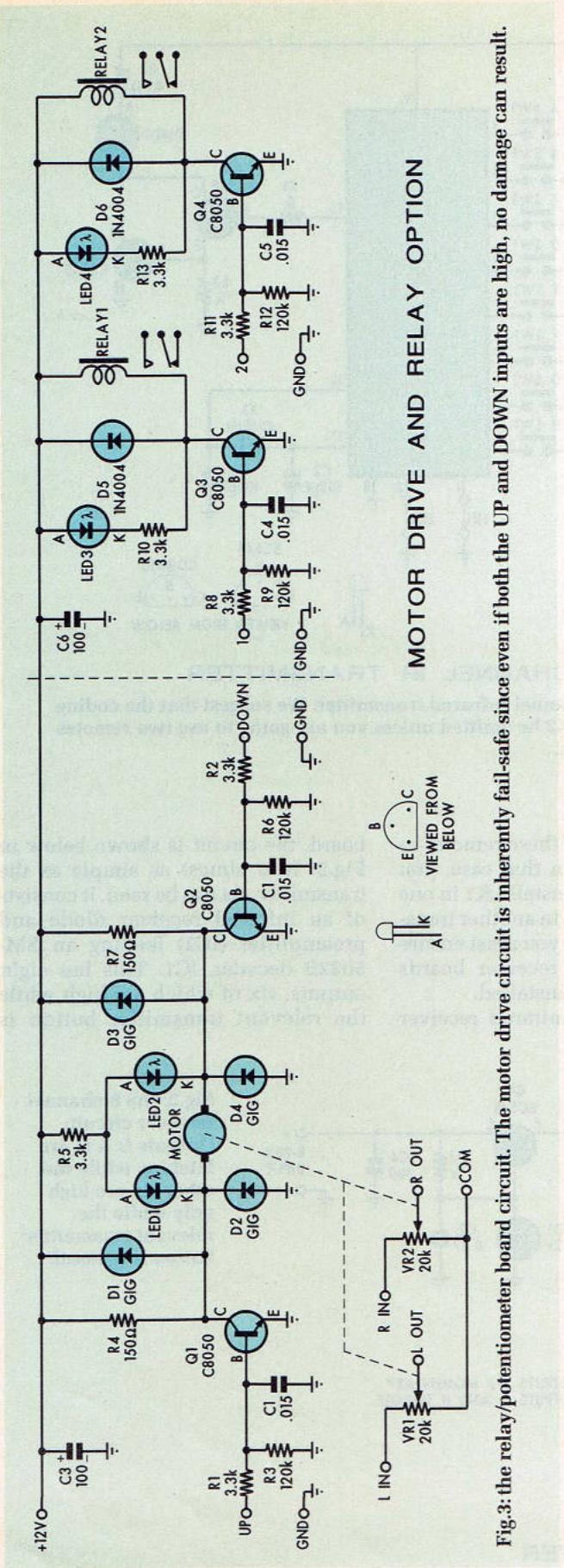


Fig.3: the relay/potentiometer board circuit. The motor drive circuit is inherently fail-safe since even if both the UP and DOWN inputs are high, no damage can result.

pressed and two of which are latching, as already mentioned above.

Actually, IC2 is a three-lead device and it is more than just a preamplifier. It contains the IR photodiode, an amplifier tuned to 38kHz, an AGC circuit and a detector. Its output is a digital pulse train identical to that generated at pin 15 of the transmitter IC but inverted in polarity. Transistor Q1 changes the signal polarity before feeding it to pin 2 of IC1.

Transistor Q2 and zener diode ZD1 act as a simple regulator circuit to provide a 5.6V supply to IC1 & IC2. The eight outputs of IC1 can only provide a drive current of about a milliamp or so, so any circuit driven by these pins must be designed accordingly.

This brings us to the add-on board which drives two relays and the stereo potentiometer.

Relay & potentiometer board

Fig.3 shows the circuit of this board and, as you can see, it is split into two parts. One part takes care of the relays and the other section controls the motor-driven potentiometer. Let's discuss the latter part first.

Transistors Q1 & Q2, together with 150Ω resistors R4 & R7, form a bridge circuit to drive the motor. Normally, only one transistor can be turned on at any time. If Q1 turns on, current flows via R4 which has almost the full 12V across it but current also flows via R7 and the motor, causing it to turn in one direction.

Similarly, if Q1 is off and Q2 is on, the full 12V is applied to R7 but current also flows via R4 and the motor, causing it to rotate in the opposite direction. Diodes D1-D4 protect the transistors from damage which could be caused by voltage spikes from the motor.

LEDs 1 & 2 light to indicate the motor direction. As labelled on the circuit, the input for Q1 is UP, corresponding to clockwise rotation of the motor. When Q1 is on, LED1 will be on. Similarly, the input for Q2 is labelled DOWN, corresponding to anticlockwise rotation of the motor. When Q2 is on, LED2 will be on.

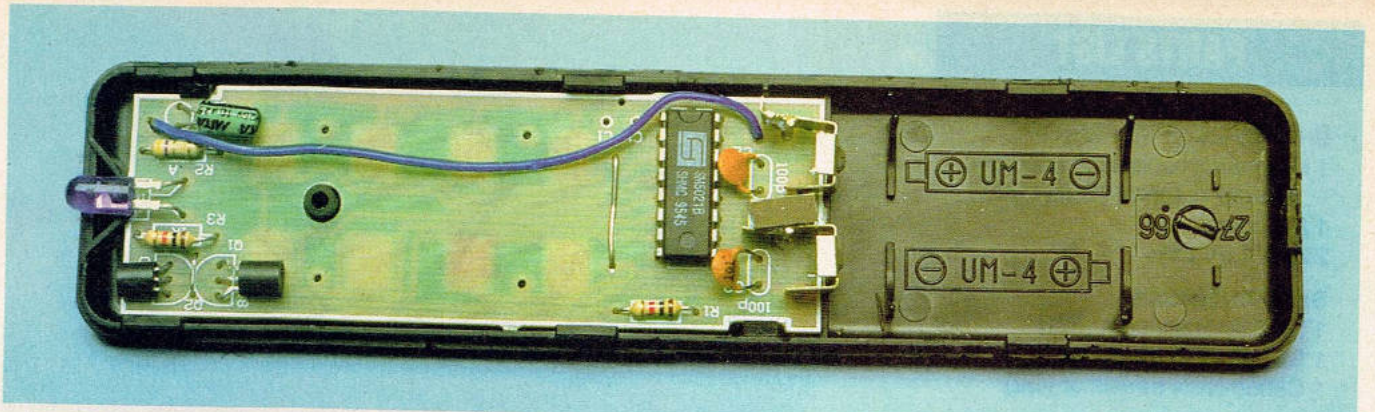
Note that this circuit has a built-in safety feature in that even if Q1 and Q2 were both turned on simultaneously, no damage would result. In that circumstance, both R4 and R7 would have the 12V applied but no voltage would appear across the motor.

Relay circuit

Now let's have a look at the relay circuit, comprising Q3 & Q4. These transistors would normally be driven from the latched outputs of the receiver board (ie, G & H). There's nothing magic about the circuit. When the input to Q3 goes high, it turns on and operates relay 1. Similarly, when the input to Q4 goes high, relay 2 operates. LEDs 3 and 4 come on when the associated relay is operated. Diodes D4 & D5 protect Q3 & Q4 against any voltage spikes generated by the relays when they are switched off.

Building a remote control system

In presenting this system, we are not proposing a cut and dried solution, so we are just featuring the three PC boards and not giving full details on how they should be hooked up to control an audio system, lighting system or whatever. We'll leave the details up to you and just



The IR transmitter board should only take a few minutes to assemble. Note that this photo shows an early version. The final version shown in Fig.4 differs slightly in a few respects.

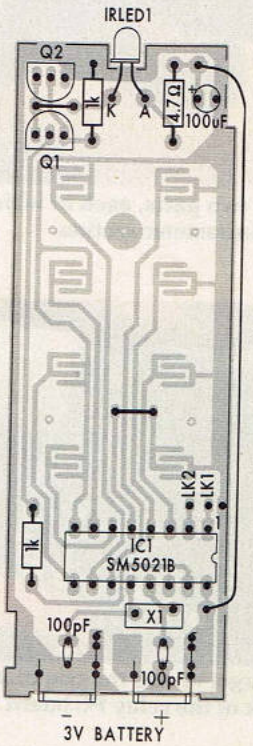


Fig.4: the component overlay for the transmitter PC board.

indicate how the boards should be connected to provide the control functions you want.

Now let's describe the transmitter assembly. As supplied, the transmitter is fully assembled and operational but it won't work with the corresponding decoder chip. You have to pull the transmitter apart by unclipping the case halves. You can do this by inserting a screwdriver into the case join down the side and levering it apart. Don't apply too much force when doing this otherwise you will damage the case.

Now lever out the existing PC board with its surface mount encoder chip. You will need to salvage the battery clips, the ceramic resonator, infrared LED and a few of the other passive components. Do not lose the rubber keyboard mat because it mates with the new PC board.

You now have to assemble the new transmitter board which uses the SM5021B encoder chip. Just assemble it as shown in Fig.4.

The next step is to assemble the receiver board, with the details shown in Fig.5. Unless you intend operating more than one of these remote control systems, leave the coding links off the transmitter and receiver boards.

Next, assemble the motor drive and relay board. This board will be supplied as one unit but it can be split into two boards, as shown in the lead photo. Mount all the small components first before installing the motor driven potentiometer. If you mount the potentiometer first, you will be unable to fit all the components which lie underneath it.

Once the two relays have been mounted you will need to wire the two protection diodes, D5 and D6, underneath the board, across the relay coils. One of the photos shows these diodes in place.

When all the boards are complete, you are ready to test each one in turn and this should be done before the receiver board and relay/potentiom-

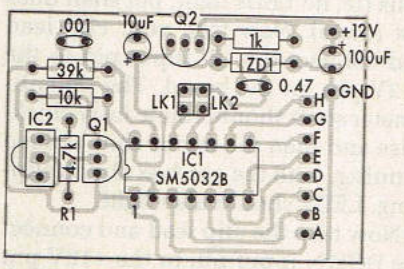
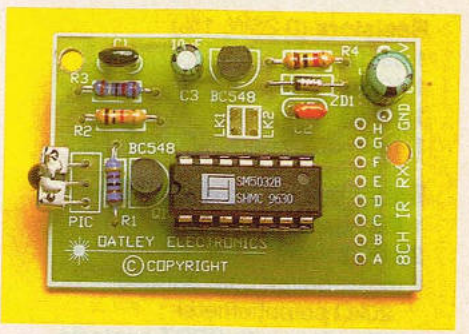


Fig.5: the component overlay for the receiver PC board.



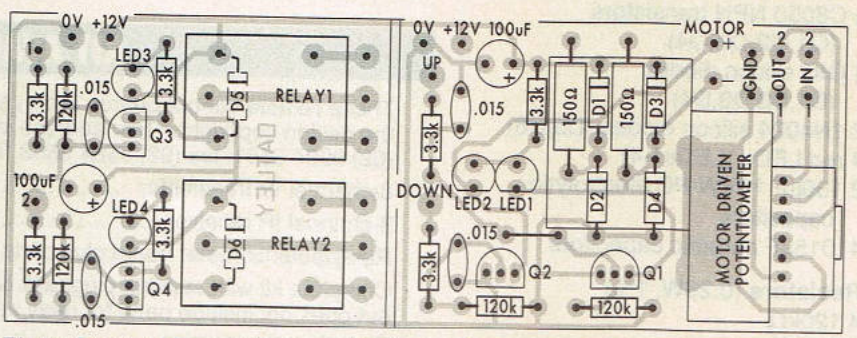


Fig.6: the parts layout for the relay/potentiometer board. Mount all the small components before the motor-driven potentiometer is installed. You will need to run two wires from the motor itself to the "motor" pins on the PC board.

PARTS LIST

8-channel IR transmitter

1 Magnavox handpiece (includes 455kHz resonator & IR LED)
1 PC board
2 AAA 1.5V cells

Semiconductors
1 SM5021B encoder (IC1)
1 BC548 NPN transistor (Q1)
1 C8050 NPN transistor (Q2)

Capacitors
1 10µF 16VW PC electrolytic
2 100pF ceramic

Resistors (0.25W, 1%)
2 1kΩ
1 4.7Ω

8-channel IR receiver

1 PC board
10 PC stakes

Semiconductors
1 SM5032B decoder (IC1)
1 PIC12043 IR receiver (IC2)
2 BC548 NPN transistors (Q1, Q2)
1 6.2V zener diode (ZD1)

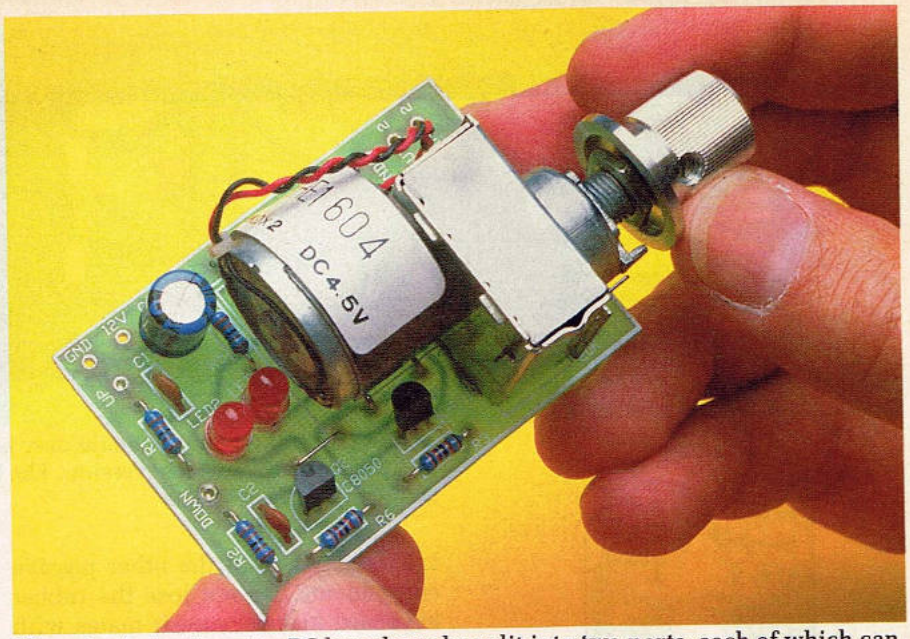
Capacitors
1 100µF 25VW PC electrolytic
1 10µF 16VW PC electrolytic
1 0.47µF monolithic ceramic
1 .001µF ceramic

Resistors (0.25W, 1%)
1 39kΩ
1 10kΩ
1 4.7kΩ
1 1kΩ

Relay/potentiometer board

1 PC board
20 PC stakes
1 motor-driven dual-ganged 20kΩ potentiometer
2 12V relays with SPDT contacts
4 C8050 NPN transistors (Q1,Q2,Q3,Q4)
4 GIG silicon diodes (D1,D2,D3,D4)
2 1N4004 silicon diodes (D5,D6)
4 red LEDs (LEDs1-4)
2 100µF 16VW PC electrolytic capacitors
4 .015µF ceramic capacitors

Resistors (0.25W, 1%)
4 120kΩ
7 3.3kΩ
2 150Ω



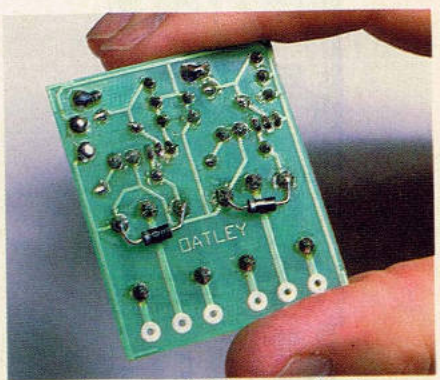
The relay/potentiometer PC board can be split into two parts, each of which can operate independently of the other. This is the potentiometer section.

eter board are wired together.

We suggest you test the relay/potentiometer board first. You will need a 12V power supply and a short lead with alligator clips at each end. The relay and potentiometer sections of the board have their own supply pins so each section can be tested independently.

Apply 12V DC to the potentiometer board and observe that nothing happens (ie, no LEDs light, pot shaft does not rotate). Now take your clip lead and connect the UP input pin to the +12V pin on the board. The potentiometer shaft should rotate fully clockwise and then the motor should keep running, with the gearbox clutch slipping. LED1 should also light.

Now take the clip lead and connect the DOWN input pin to the +12V pin on the board. The potentiometer shaft should rotate fully anticlockwise and then the motor should keep running, as before. LED2 should also light.



Don't forget to add the two diodes on the back of the relay PC board.

Now test the relay board. Apply 12V DC and note that nothing happens, then use your clip lead to connect pin 1 on the board to +12V. You should hear relay 1 click and LED3 should light. Similarly, use your clip lead to connect pin 2 on the board to

KIT AVAILABILITY

These remote control boards are available from Oatley Electronics, who own the design copyright. Their address is PO Box 89, Oatley, NSW 2223. Phone (02) 9584 3561; fax (02) 9584 3563. The prices are as follows:

8-channel IR transmitter	$20
8-channel IR receiver	$20
Relay/potentiometer board plus parts for motor drive section	$16
Complete kit with suitable plugpack & RCA leads (includes all of above but does not include parts for relay section)	$55
Parts for relay section	$8

Please add $5 to all prices for postage and packing.

+12V. You should hear relay 2 click and LED2 should light.

Testing the transmitter

Testing the transmitter on its own is not practical unless you have a camcorder or some sort of video camera. If you do, you can use the camera's viewfinder to see if light is emitted when any of the transmitter buttons are pressed. However, while that tests the infrared side of things, it does not indicate that the buttons control the right receiver outputs. The way around this is to first connect 12V DC to the receiver board, then check that around +5.6V is present at the emitter of Q2, at pin 14 of IC1 and at pin 3 of IC2.

Now aim the transmitter LED at the receiver's detector window and use your multimeter to check that each output pin on the board goes high when the relevant button is pressed. The outputs should be as follows:

CD	pin H
Tuner	pin G
Track	pin E
Standby	pin B
Stop	pin F
Play	pin A
Volume -	pin D
Volume +	pin C

Note that pins G & H are the latching pins and these drive the relays.

Connecting up

If you've got this far, making the board-to-board connections won't be a problem. Pin C on the receiver board is connected to the UP input on the potentiometer board while pin D is connected to the DOWN input. Pins H & G are connected to input pins 1 & 2 respectively on the relay board.

If you wanted to connect a second potentiometer board, you could use any of pins A, B, E and F for the UP and DOWN functions. Alternatively, you could use any of the same pins to operate additional relay boards, although they would only be energised while the relevant transmitter button was pressed.

Finally, if you have previously purchased the 8-channel IR transmitter and receiver boards, the transmitter buttons will not provide the correct functions. On the previous transmitter board (February 1996), the Volume button controlled latching outputs which is not appropriate for controlling the potentiometer board. **SC**

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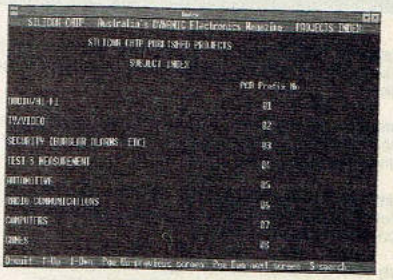

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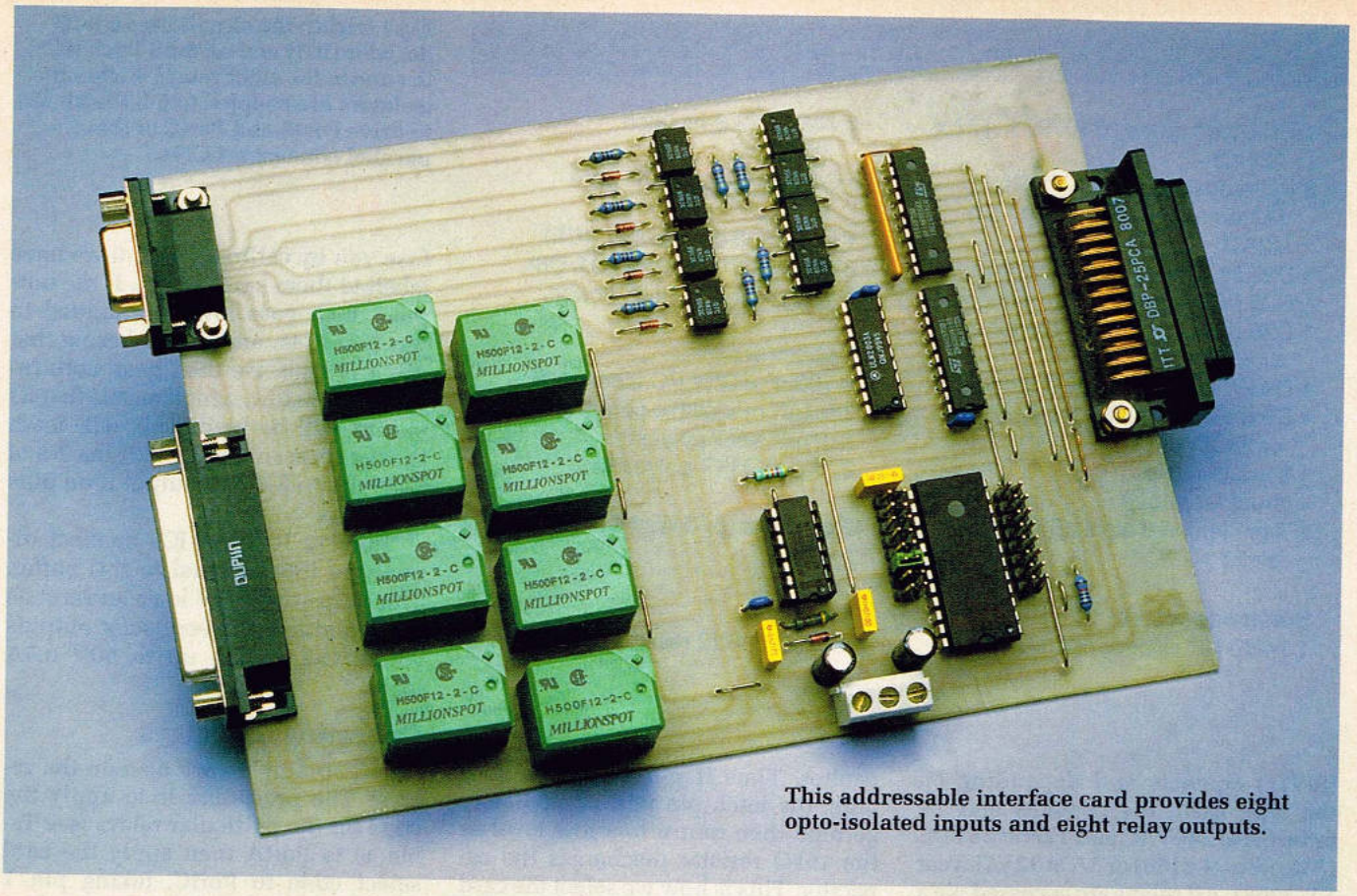


This addressable interface card provides eight opto-isolated inputs and eight relay outputs.

A flexible interface card for PCs

This addressable interface card provides eight opto-isolated inputs and eight relay outputs. It is addressed from the parallel port of your computer and you can have more than one card, each with a different address, hooked to the same port.

By RICK WALTERS

Got a control application for your computer that can't be done with your existing hardware? Perhaps you want to design a security system around an older computer. Whatever the reason, there are a host of applications for this input/output card which can be connected to any PC with a standard parallel port. That means it can be used with old PC XTs, 286 or 386 machines which might otherwise be gathering dust. And of course, it can be used with 486 and Pentium machines as well.

You could have up to eight of these cards daisy chained and connected to one parallel printer port on a PC. The cards can be set up with an address from 1 to 8, making them individually addressable, or if the need arises, two or more can be coded with the same address in a master-slave setup.

Capabilities

This interface card is capable of monitoring eight opto-isolated input lines. The inputs to the PC port are normally high and are taken low (via the opto-isolator) when the card input line is grounded. These eight input lines and ground are accessible via a 9-pin "D" female connector.

The card can also switch eight relays. Each relay has changeover

PARTS LIST

1 PC board, code 07107971, 177 x 125mm
8 PC-mount relays (RLY1-RLY8) (Altronics S-4160; Jaycar SY-4066)
1 D25 PC-mount male connector
1 D25 PC-mount female connector
1 D25 male connector (solder cup or IDC)
1 D9 PC-mount female connector
1 D9 male connector (solder cup or IDC)
1 8 x 2-pin strip
1 shunt for above
1 3-pin terminal block (5.08mm pitch)

Semiconductors
1 74HC137 decoder (IC1)
2 74HC573 8-bit latch (IC2,IC3)
1 74HC02 quad NOR gate (IC4)
1 ULN2803 octal buffer (IC5)
8 4N28 opto-isolators (O1-O8)
9 1N914 small signal diodes

Capacitors
2 100µF 25VW PC electrolytic
3 0.1µF monolithic ceramic
1 .01µF MKT polyester
2 .001µF MKT polyester

Resistors (0.25W, 1%)
2 47kΩ
1 10kΩ
8 4.7kΩ
1 47kΩ SIP (8 resistor 9 pin)

Fig.1 (right): the circuit uses a BCD decoder (IC1) and an 8-bit latch (IC2) to control the eight relays. Eight opto-isolators are coupled to 8-bit latch IC3 to drive PortB and PortC of the parallel connector CON1.

(SPDT) contacts and depending on the type used, the contacts may be rated 6A at 240VAC and 12A at 28VDC (Altronics S-4160) or 3A at 12V (Jaycar SY-4066). All relays are accessed via a 25-pin "D" female connector. Note that the PC board tracks and the connector are not rated for 240VAC and they would not carry this current but if high currents were to be switched, connections could be made straight to the relay pins.

These features make the card suitable for a wide range of interface applications.

Circuit description

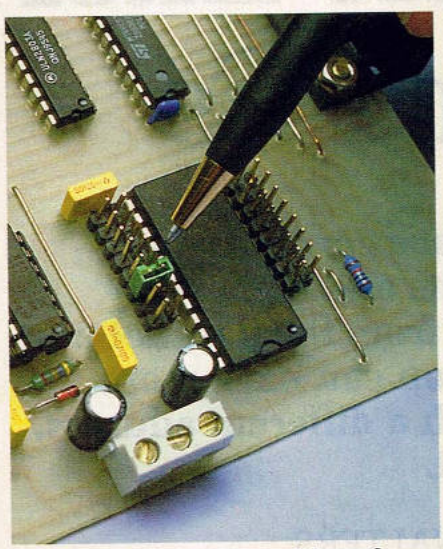
The full circuit is shown in Fig.1. IC1 is a 74HC137 latched one-of-eight active-low decoder. This means that any BCD (binary coded decimal) code which is present on the three input lines (A,B,C) will cause the output corresponding to this code to change from its normal level of +5V (high) to 0V (low). The eight outputs are pins 7 and 9 to 15.

While the latch enable, pin 4, is high, the outputs will change in sympathy with the input code but once the latch pin is low, the input code is stored or latched. This allows us to select one of the outputs, latch it, then alter the code on the input lines while that output stays selected.

To this end, the latch enable pin is AC-coupled through the .001µF capacitor. Thus if pin 4 of IC4b goes high, the latch pin will immediately go high then return to a low level as the 10kΩ resistor discharges the capacitor. This is how we select the card from the parallel port.

The three input lines can only address outputs 0 - 7 so rather than confuse you by calling it card 0 we have labelled them cards 1 to 8. If the output which goes low is jumpered to pin 2 of IC4a, and remembering that pin 4 is high, we then have both inputs of IC4a low, which means that its output will be high. This will latch the data present on PortA (pins 2-9 of CON1) into IC2 and output it on pins 12-19.

Pins 12 to 19 of IC2 connect directly to IC5, an octal (eight) buffer. This chip accepts 5V logic levels at its input and has open-collector outputs which can switch up to 50V 0.5A loads.



The I/O Card is addressed from the parallel port of your computer and you can have more than one card, each with a different address, hooked to the same port. Note that this is the prototype card and some changes have been made, as can be seen from the component overlay diagram of Fig.4. The current artwork uses a 16-pin chip for IC1.

Operating the relays

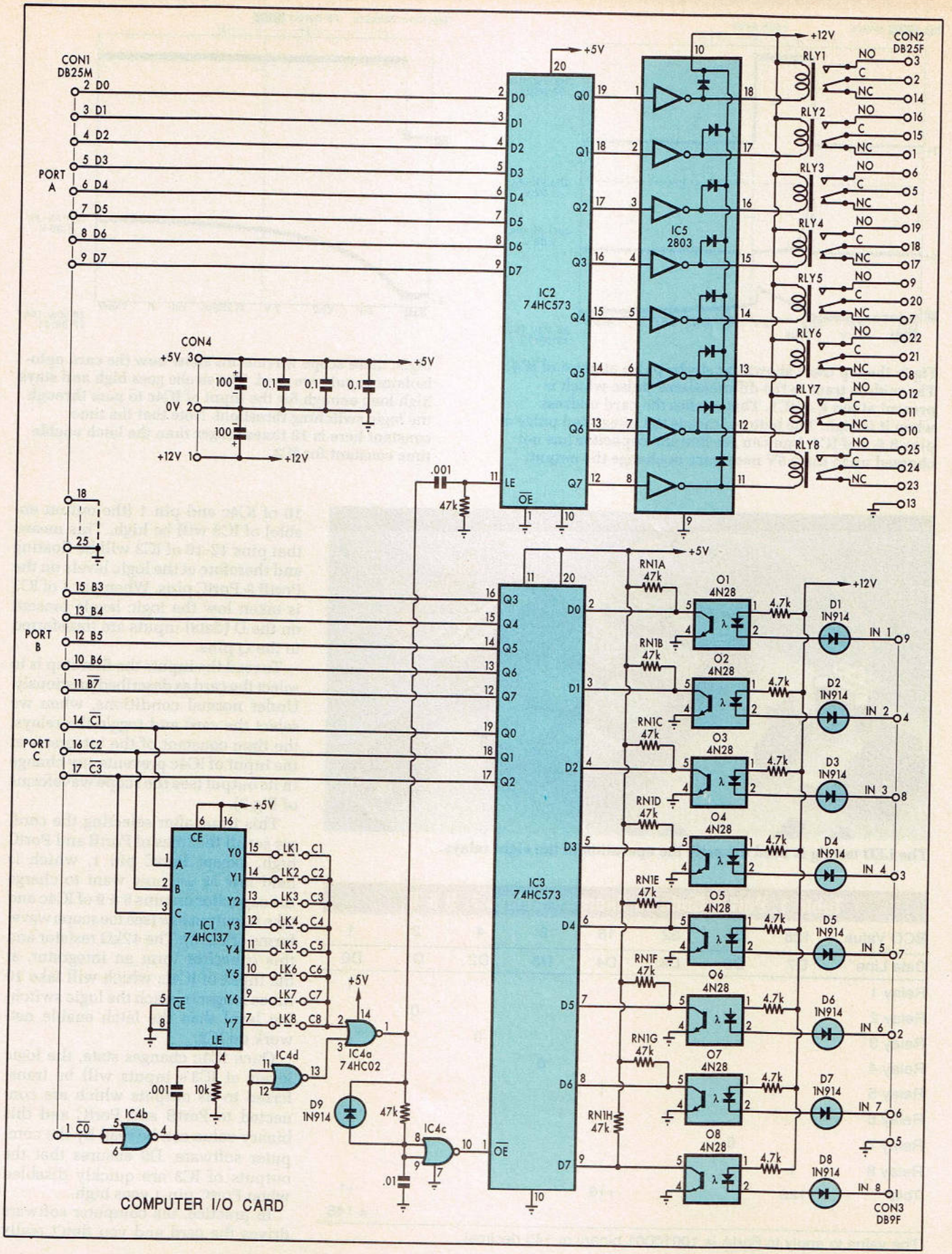
OK, so how do we operate the relays? The procedure is to apply the code for the particular relays (see Table 1) to PortA then apply the card select code to PortC, taking pin 1 (which is normally high) low, then back high again.

Reading the eight inputs is not quite so straightforward. In the newer PCs, the PortA lines are bidirectional; ie, they can be used for inputs as well as outputs. With the older-style machines they can only be used as output lines. Fortunately, the PortB and PortC lines can be used as inputs but we have to use them both to get our eight lines. Now you will realise why it was necessary to latch the PortC data in IC1.

The eight inputs (pins 2-9) of IC3 are pulled high with 47kΩ resistors and each resistor has an opto-isolator output connected between it and ground. If the LED in the opto is lit the transistor will pull the pin low. This will be the case if the corresponding diode is grounded.

Unfortunately, computer boffins count from zero, unlike normal human beings who were taught to start from one. This means that diode D1 controls input port D0 and so on. We could label the IC pins D1-D8, but we prefer to draw ICs the way you will find them in the data book, otherwise there could be even more confusion.

With the I/O card de-selected, pin 1 of IC4a will be low and therefore pin


CON1
DB25M
PORT A
PORT B
PORT C
CON4
IC1
74HC137
IC2
74HC573
IC3
74HC573
IC5
2803
IC4a
74HC02
IC4b
IC4c
IC4d
RLY1
RLY2
RLY3
RLY4
RLY5
RLY6
RLY7
RLY8
CON2
DB25F
CON3
DB9F
+5V
+12V
0V
COMPUTER I/O CARD

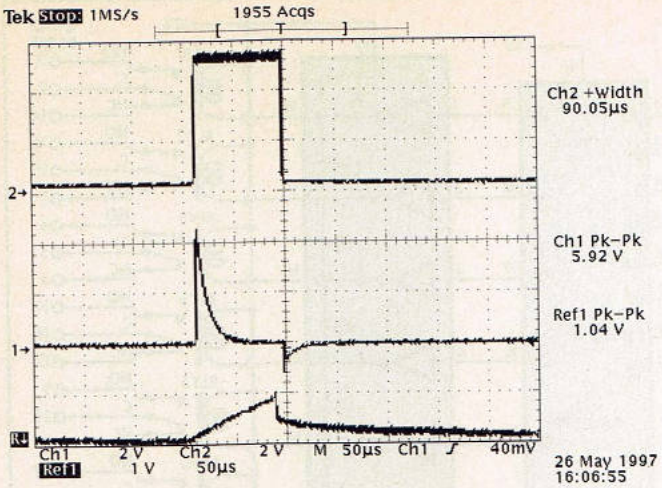


Fig.2: the top trace shows the strobe pulse at pin 4 of IC4. The middle trace is the differentiated pulse which is present at pin 4 of IC1. This latches the card address when it is high. The bottom trace is the integrated pulse at pins 8 & 9 of IC4. You can see that the capacitor has not charged up to the 2.5V necessary to change the output.

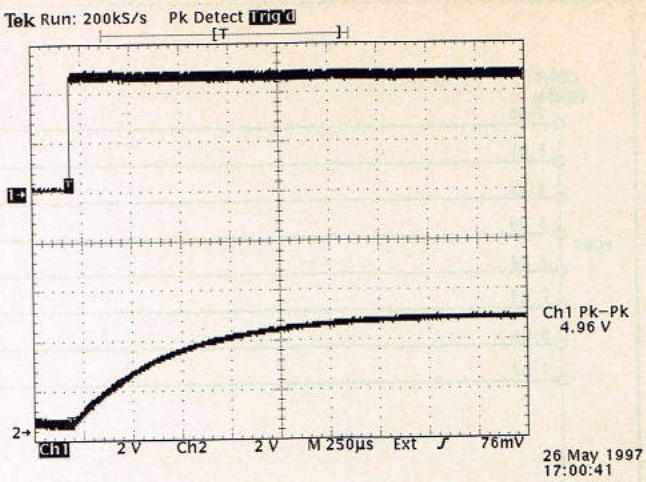
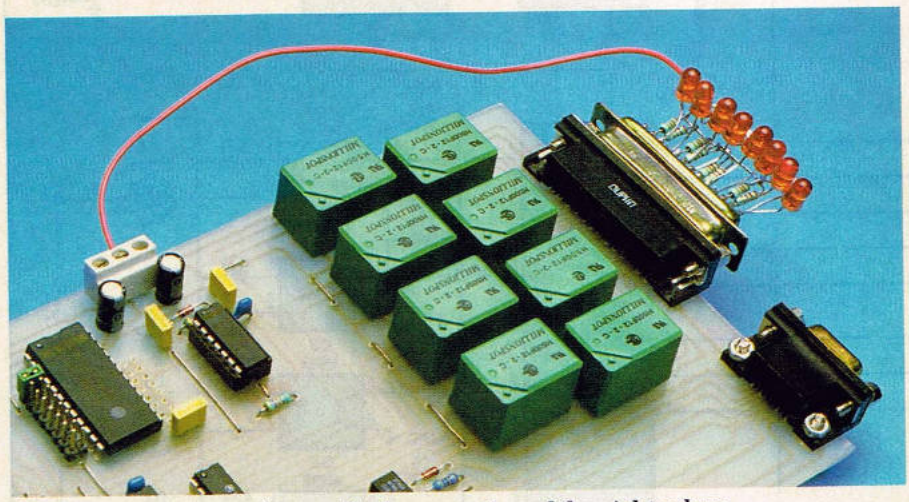


Fig.3: these scope waveforms show how the card opto-isolator inputs are read. The strobe goes high and stays high long enough for the input of IC4c to pass through the logic switching threshold. Note that the time constant here is 10 times longer than the latch enable time constant for IC2.



The LED test jig is used to verify the operation of the eight relays.

Table 1: Port A Code To Energise Relays 1, 5 & 8

BCD Value	128	64	32	16	8	4	2	1
Data Line	D7	D6	D5	D4	D3	D2	D1	D0
Relay 1								1
Relay 2							0	
Relay 3						0		
Relay 4					0			
Relay 5				1				
Relay 6			0					
Relay 7		0						
Relay 8	1							
Total	128			+16				+1 = 145

The value to apply to PortA is 10010001 binary or 145 decimal

10 of IC4c and pin 1 (the output enable) of IC3 will be high. This means that pins 12-19 of IC3 will be floating and therefore at the logic levels on the PortB & PortC pins. When pin 1 of IC3 is taken low the logic levels present on the D (data) inputs are transferred to the Q pins.

To read the inputs the first step is to select the card as described previously. Under normal conditions, when we select the card and toggle the relays, the time constant of the integrator at the input of IC4c prevents any change in its output (see the scope waveforms of Fig.2).

This time, after selecting the card, we set all the lines of PortB and PortC high, except PortC pin 1, which is held low as we now want to charge the capacitor on pins 8 & 9 of IC4c and take its output low (see the scope waveforms of Fig.3). The 47kΩ resistor and this capacitor form an integrator, at the input of IC4c, which will take 10 times longer to reach the logic switching level than the latch enable network on IC2.

Once IC4c changes state, the logic levels at IC3's inputs will be transferred to its outputs which are connected to PortB and PortC and this binary value can be read by the computer software. D9 ensures that the outputs of IC3 are quickly disabled when PortC pin 1 goes high.

In practice, the computer software drives the card and you don't really

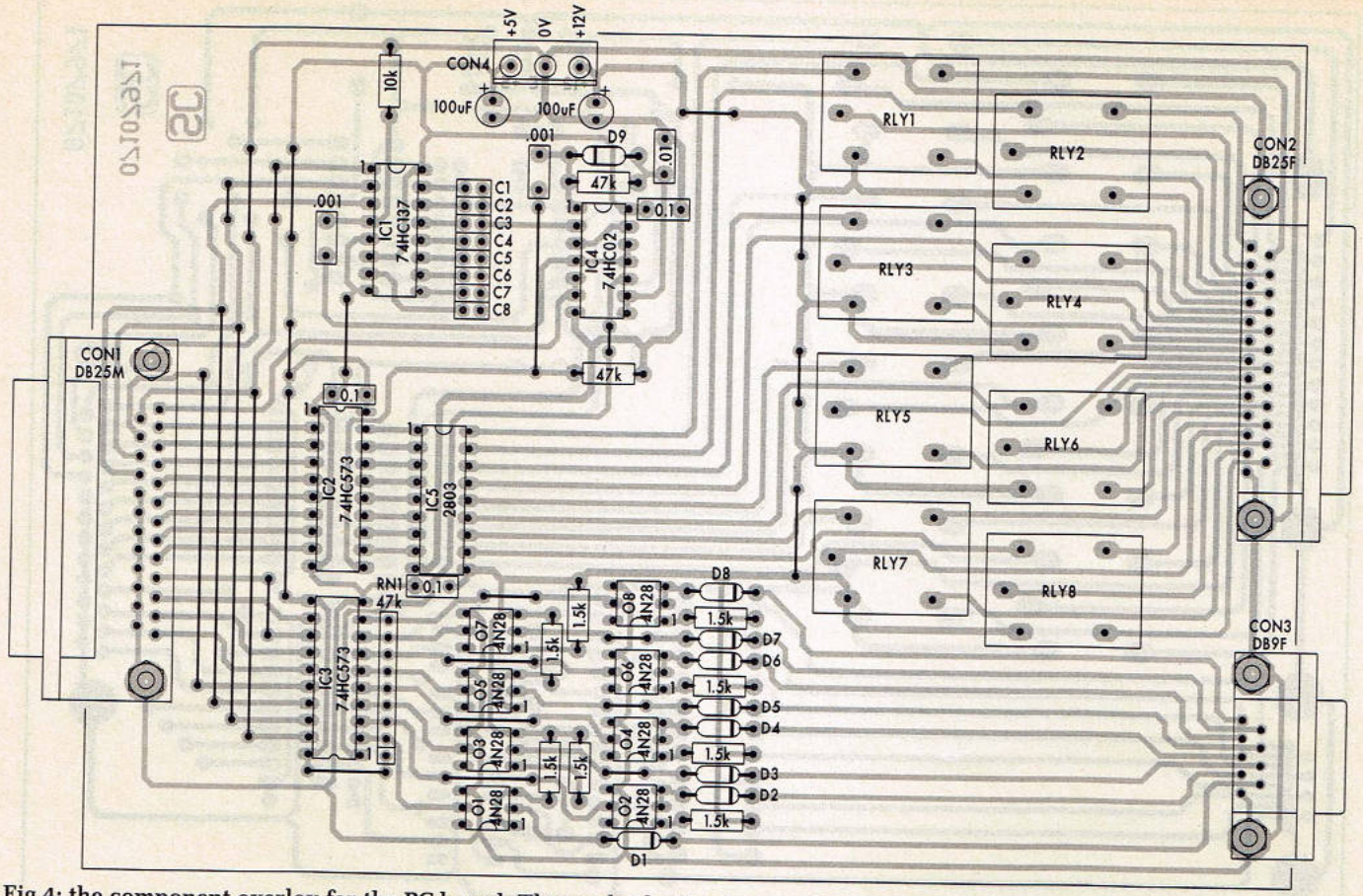


Fig.4: the component overlay for the PC board. The card selection jumper is to the right of IC1. For convenience, all the input-output connections to the card are made with D connectors.

have to think about the circuit machinations in order to be able to use it.

Building the card

The component overlay of the PC board is shown on Fig.4.

You can begin by checking the etch pattern on the PC board with the full size artwork of Fig.6. Fix any faults that might be present before you start installing the parts.

Fit and solder the 23 links, followed by the resistors and diodes. Next, insert the ICs along with the resistor network (black dot adjacent to pin 1) noting that IC1, IC2, IC4 and IC5 face one edge of the board and the rest face the other edge. The last group is the capacitors, connectors and relays. Check all the soldering again once you have finished as it is quite easy to miss a row of IC pins or one resistor network pin.

Testing it

For the big test you will need a 25-way D cable to connect your computer printer port to the card and a power supply which can deliver 5V and 12V. Connect the power supply to CON4, checking that the +5V on the supply goes to the correct connector terminal. Set the jumper to C1. Connect the male end of the cable to the computer printer socket, the female end to the card and turn on the power supply.

Relay test

It is possible that several relays will click in, depending on the logic levels on the output of IC2. If nothing is heard don't despair. Load BASIC into your computer and type in lines 10-100 of the program shown in Listing 1. You need not type the comments (lower case); they are only there to explain what each line does.

When you run it, each relay should energise in turn, with a 1-second delay between steps. If your relays don't step at all, first check that you have selected card one.

Next, check the voltage at pin 2 of IC4. It should be 0V. If you remove

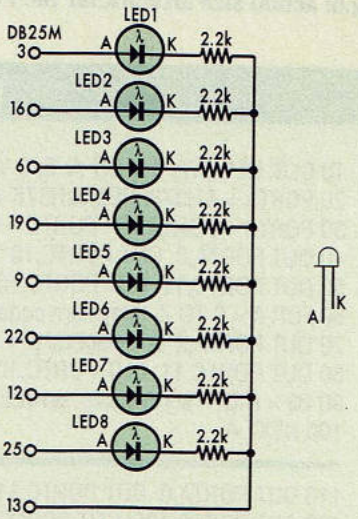


Fig.5: use this circuit to make up a jig for checking relay operation on the board.

OUT PORTC,10 from line 50 and run the program again, both pin 2 and pin 3 of IC4 should be low and consequently pin 1 should be high.

Fig.5 shows the circuit of a LED array which can be connected to a 25-

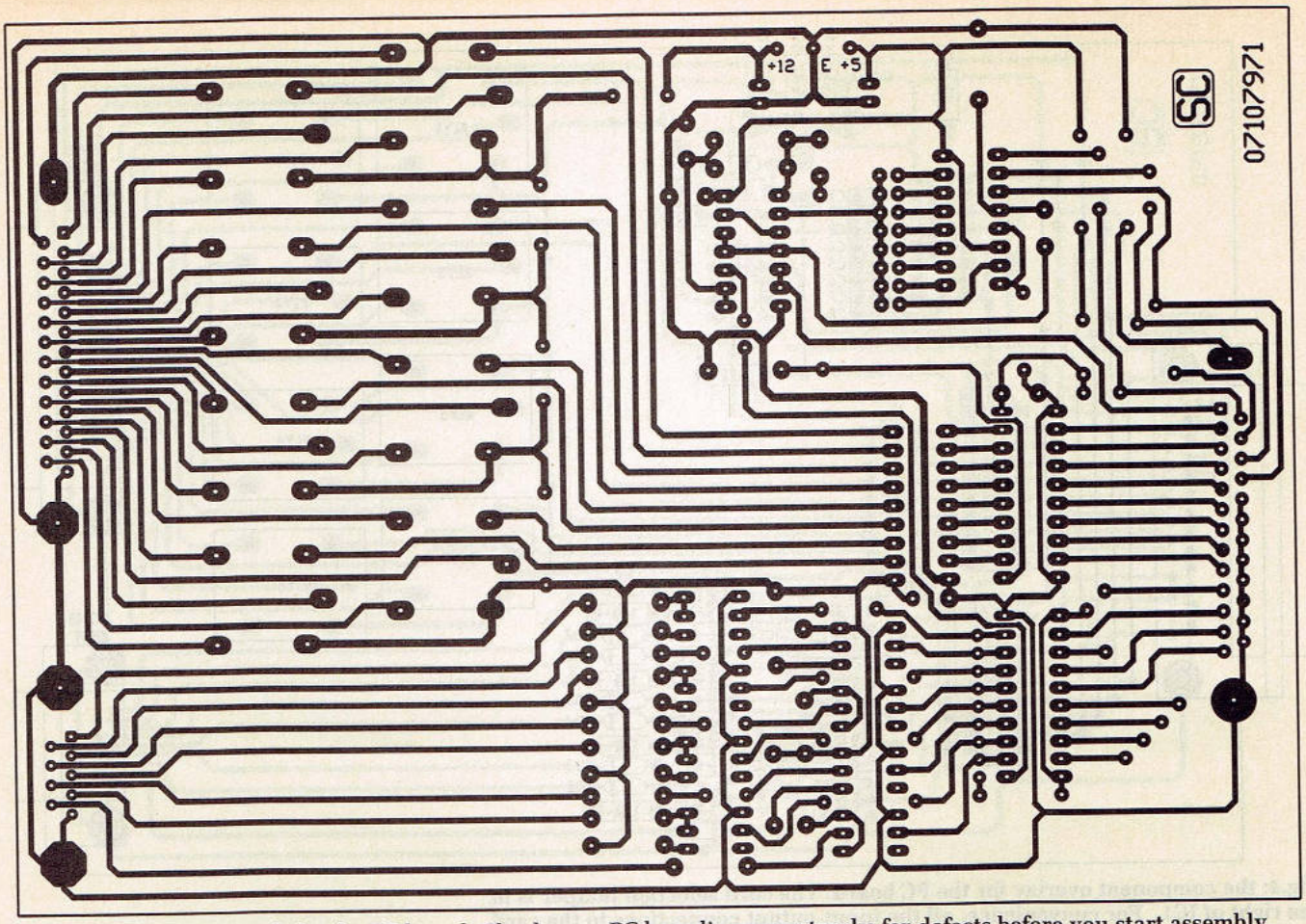


Fig.6: actual size artwork for the PC board. Check your PC board's copper tracks for defects before you start assembly.

LISTING 1

```
10 CLS: KEY OFF: DEFINT A, B, C 'define A, B, C as integers
20 PORTA = &H378: REM &H378 is for LPT1. use &H278 for LPT2
30 PORTB = PORTA + 1: PORTC = PORTB + 1 'define port addresses
40 OUT PORTA,0: OUT PORTC,10 'turn all relays off, take C0 high
50 OUT PORTC,11: OUT PORTC,10 'select card one, C0 low then high
60 FOR A = 0 TO 7 'relays are coded 1, 2, 4, 8, 16, 32, 64, 128
70 OUT PORTA,2^A 'select relay 1 to 8 in turn
80 OUT PORTC,11: OUT PORTC,10 'select card one, strobe high then low
90 B$ = RIGHT$(TIME$,2): WHILE RIGHT$(TIME$,2) = B: WEND 'wait one second
100 NEXT A
```

```
110 OUT PORTA,0: OUT PORTC,11 'turn all relays off
120 OUT PORTB,120: OUT PORTC,5 'take input lines high
130 FOR A = 1 to 200: NEXT 'delay for IC4c increase value if necessary
140 LIN = 0: B = INP(PORTB): C = INP(PORTC) 'read port input values
150 IF (B AND 128) THEN BIN = B - 135 ELSE BIN = B + 121 'complement bit 8
160 CIN = C AND 14 'mask high bits and C0
170 IF (C AND 2) = 0 THEN CIN = CIN + 2 ELSE CIN = CIN - 2 'complement bit 2
180 IF (C AND 8) = 0 THEN CIN = CIN + 8 ELSE CIN = CIN - 8 'complement bit 8
190 CIN = INT (CIN/2): TIN = 255 - (BIN + CIN)
200 FOR A = 0 TO 7: IF TIN/2^A = 1 THEN LIN = A + 1 'find low line
210 NEXT
220 LOCATE 24,20: PRINT "Line";TIN; 'print it
230 GOTO 140 'loop
```

way D-connector to check relay operation. This is much more effective than trying to listen for relays clicking.

Input test

Now add the remaining lines (110-230) of Listing 1 and run the program again. After the relays stop sequencing, the number 0 should appear at the bottom of the screen. Ground the cathodes of D1-D8 in turn and the corresponding line number should show on the screen.

Pressing the Ctrl and C or Ctrl and Break keys together will get you out of the loop. The fun and games in lines 150-190 compensate for the logic inversion of B7, C1 and C3 on CON1.

If you have problems with this section you will have to ground the diode and check that the corresponding data input on IC3 goes low. With pin 1 of IC3 low, the Q output should mimic the D input. If this is working, then check for open circuit tracks between IC3's Q outputs and the corresponding pin on CON1. **SC**

Points Controller FOR MODEL RAILWAYS

This Points Controller board uses a capacitor discharge circuit to energise the coils on a twin-solenoid switch machine. One Points Controller board can be used to operate all the points on a model railway layout.

Most model railway enthusiasts operate their points with a twin solenoid connected to a 15V supply. However, if you keep your finger on the button for just a moment too long, you can easily burn out the solenoid coil. This points controller avoids that problem.

Design by RICK WALTERS

As any keen model railway enthusiast can confirm, even the simplest of model layouts include a few sets of points and most feature quite a few, for sidings, shunting yards and spur lines. While you can operate points by hand (the "big hand in the sky") or by Bowden cables, that rapidly becomes unwieldy and unrealistic for all but the smallest layouts.

Hence most enthusiasts operate their sets of points by twin solenoid assemblies which are usually referred to as switch machines. The most commonly available type is made by Peco and can be used for O, HO and N scale layouts. They are available from model railway retailers for about $7.

As can be seen from one of the photos accompanying this article, these twin solenoid assemblies consist of two coils which drive a common solenoid shaft and a rightangle pin which protrudes from both sides of the assembly. The switch machine is mounted under the baseboard of the model railway layout and the solenoid operated pin fits into a hole in the sleeper of the moveable rail section of the points.

To operate the points in one direction, one of the solenoids is briefly energised, after which the points lock into their new position. To move the points back again, the other solenoid is briefly energised.

In normal practice, the solenoid coils are energised from a 16V AC or DC power supply, with each coil connected via a pushbutton switch. The idea is that you briefly push the switch to operate the points for the new train direction. The operative word here is "briefly". If you lean on the switch for more than a few seconds, the energised coil will burn out.

The reason for burn out is pretty easy to understand. Each solenoid coil is wound with lots of turns of very fine enamelled copper wire and the total coil resistance is typically around 4.5Ω. With 15V across the coil, the internal dissipation will be $V^2/R = (16)^2/4.5 = 50W$. No wonder they can expire in a brief puff of smoke!

The solution to this problem is to energise the solenoid coils with a ca-

14 Model Railway Projects

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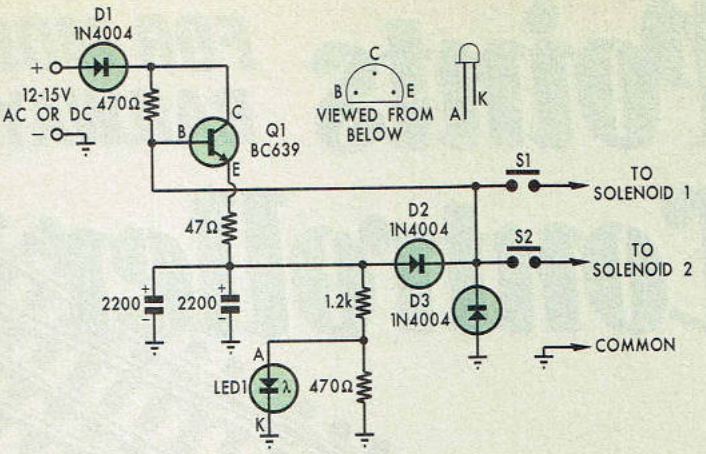


POINTS CONTROLLER

Fig.1: the 2200µF capacitors are charged via D1, Q1 and the 47Ω resistor. The capacitors' charge can then be dumped into the solenoid coils via pushbutton switches S1 or S2.

pacitor discharge circuit. This charges up a capacitor to around 15V or so and then the capacitor's charge is dumped via the respective pushbutton into the solenoid coil to be energised. This operates the points, discharges the capacitor and even if the pushbutton remains depressed, no harm can be done to the solenoid coil since the capacitor cannot supply any more current.

Fig.1 shows the circuit. The power supply can be any 12V to 15V DC or AC source, with a 12V plugpack being a safe and convenient approach. This is fed via diode D1 and transistor Q1 to one or two 2200µF capacitors. From there, diode D2 couples the capacitors' voltage to pushbutton switches S1 and S2. These switches then discharge the 2 x 2200µF capacitors via one or other of the twin solenoids in the switch machine.

When power is first applied, the 470Ω resistor between collector and base of Q1 ensures that it is fully turned on and so it charges the 2200µF capacitors. The charge current is limited to a safe level (250mA maximum) for Q1 by the series 47Ω resistor at its emitter. The capacitors only take a few seconds to fully charge, by which time LED1 will be fully alight.

The 1.2kΩ and 470Ω resistors form a voltage divider which prevents LED1 turning on until the voltage across the capacitor reaches 10V. This means that LED1 acts as a "ready" indicator.

When either S1 or S2 is pressed, not only does it discharge the 2200µF capacitors, it also pulls the base of Q1 below its emitter, so it is completely turned off. Thus, once the capacitor is fully discharged, the only current which flows into the coil is from the 470Ω base pull-up resistor. As this current is around 20-30mA, depending on the supply voltage, there is no chance of damaging the solenoid coil. Q1 stays turned off, until the pushbutton is released, whereby the 2200µF capacitors begin to charge again.

You might wonder about the functions of the three diodes in the circuit. Are they really necessary? Well, yes. Otherwise we would not have included them.

Diode D1, provides reverse polarity

PARTS LIST

1 PC board, code 09107971, 51 x 38mm
2 momentary contact pushbutton switches (S1, S2)
1 BC639 NPN transistor (Q1)
3 1N4001 or 1N4004 silicon diodes (D1-D3)
1 red LED (LED1)
1 or 2 2200µF 25VW PC electrolytic capacitors (see text)
1 1.2kΩ 0.25W, 1% resistor
2 470Ω 0.25W, 1% resistor
1 47Ω 0.25W, 1% resistor

protection for the circuit if a DC supply is used and acts as a rectifier if AC is used. Diode D3 is include to prevent damage to the base of Q1 from voltage spikes which can be produced by the solenoids if there is contact bounce in the pushbutton switches (virtually all switches have some contact bounce).

Finally D2 is included to allow Q1 to turn on and turn off correctly. Without D2, the base of Q1 would be connected directly to the 2200µF capacitors and so the transistor would be biased off.

Assembling the board

With such a small PC board, it will not take long to assemble all the components onto it. Make sure the diodes and transistor are installed correctly, otherwise the circuit won't work.

Our circuit and photos show the PC board fitted with two 2200µF capacitors but only one may be necessary. How do you know? Well, you could try the circuit with only one 2200µF capacitor fitted and see if it works satisfactorily. If so, then that's all you need. However, if your input voltage to the circuit is 12V or less, you may need to fit two 2200µF capacitors to ensure that you have enough energy storage to fire the solenoids every time.

We envisage that the points controller board will be installed under the control panel for your layout. LED1 will be mounted on the control panel, adjacent to the pushbuttons S1 & S2.

By the way, we suggest you try connecting the board to a switch motor and operating it before it is installed in your layout.

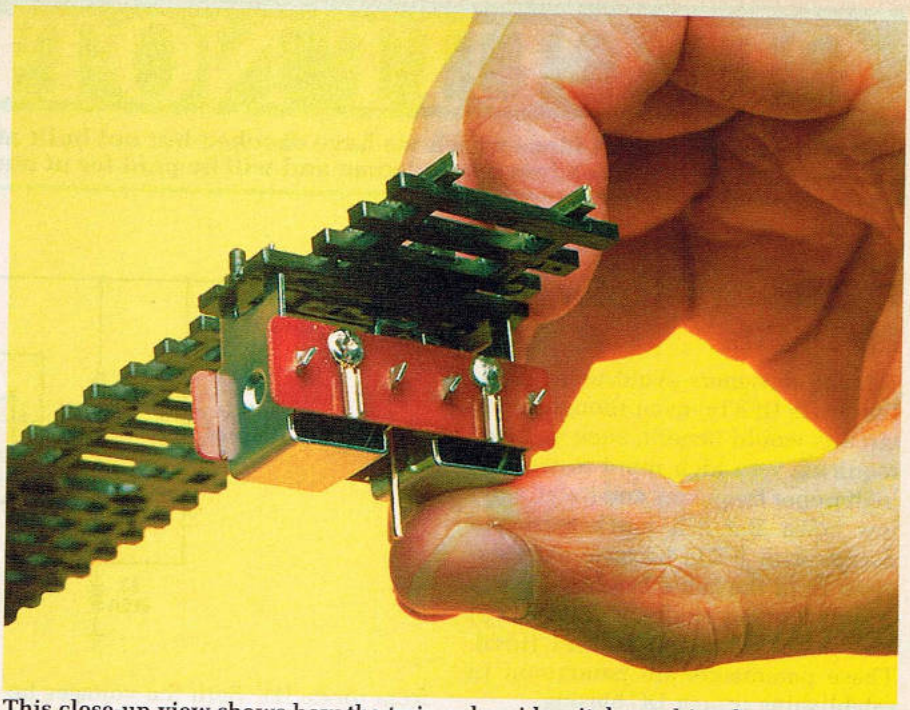
Multiple points operation

Note that while the circuit of Fig.1 and the PC overlay diagram of Fig.2 show provision for only two pushbuttons, S1 & S2, you only need to build one of these point controller boards to drive all the points switch motors on your layout.

All you need to run extra points is an extra pair of pushbuttons for each set. So in theory, you could have 50 sets of points and 50 pairs of pushbuttons all run from the one points controller board.

In practice though, it might be prudent to run no more than a dozen sets of points from each board. This would simplify the wiring and make troubleshooting easier if you ever have a short or an open circuit in your wiring.

If you do decide to run multiple points controller boards, you can power them all from the same 12-15V source. **SC**

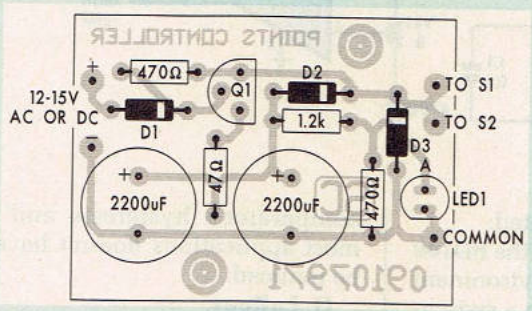


This close-up view shows how the twin-solenoid switch machine fits under the points. A pin is fitted at rightangles to the solenoid shaft to drive the moveable rail section of the points.

Points or Turnouts?

If you are a model railway enthusiast you will find that American, Australian and European modelling magazines have different terminology for items such as points. Australian and English magazines refer to them as "points" while American magazines refer to them as "turnouts" or "switches".

In fact, operations in railway marshalling yards are referred to as "switching" in American parlance and "shunting" in Australian or English magazines.



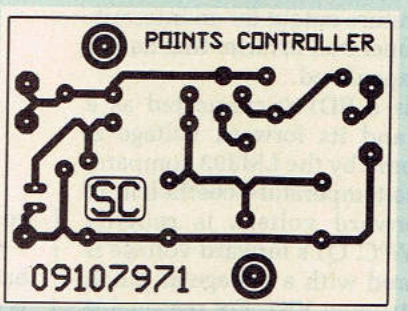


Fig.2 (left): the component overlay for the PC board. Note that you can fit one or both of the 2200µF capacitors, depending on your input supply voltage (see text). Fig.3 at right shows the actual size artwork for the PC board.

CIRCUIT NOTEBOOK

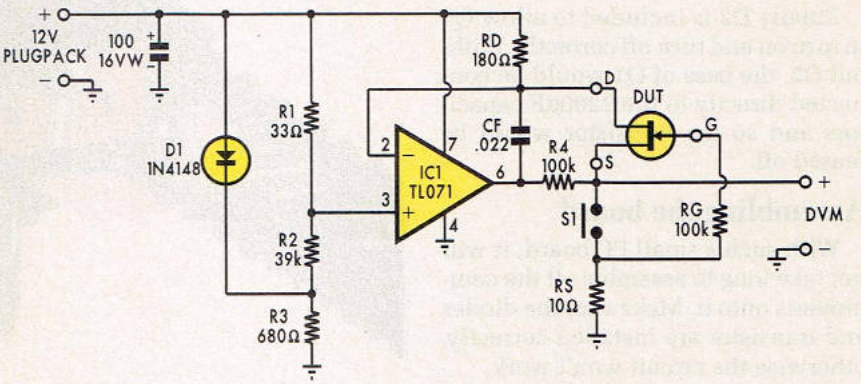
Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

JFET tester adaptor for DMMs

Many designers avoid using junction FETs (JFETs) even though many circuits would benefit, such as those requiring very high input resistance, high upper frequency and (relatively) low noise. But it is much harder to design with JFETs because even devices from the same batch will have widely varying pinch-off voltage (Vp) and drain saturation current (Idss). These parameters are paramount in establishing proper DC biasing.

The tester described here enables one to quickly measure these vital parameters of an N-channel JFET to approximate forward conductance and to match transistors (eg, for use in a differential long-tailed amplifier stage).

With switch S1 open, op amp IC1 functions as a current regulator to the JFET under test. The voltage drop across resistor R_D, due to the JFET's drain current, is compared with a portion of the reference voltage derived from diode D1. Both the voltages being compared will be close to the positive supply rail and the TL071 op amp specified can cope with this condition. As a result of the voltage comparison at its inputs, the op amp adjusts the JFET's source voltage accordingly. The gate of the JFET is tied to 0V.



The resulting current through the JFET is about 2.8µA and the voltage between gate and source, as measured by the DVM, is the pinch voltage.

With switch S1 closed, the gate and source of the JFET under test are at equal potential. Under these conditions, the DVM measures the voltage across the source resistor R_S and when the measurement value is divided by 10, the result is the drain saturation current (Idss).

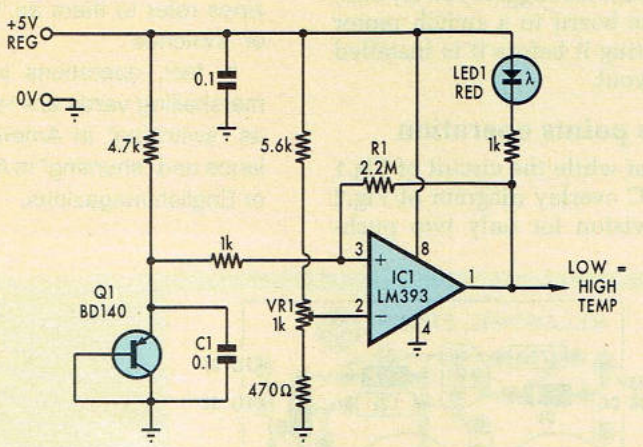
Resistors R4 and R_G must be included. These will limit the current flowing through the gate-channel junction if the JFET is inserted incorrectly. Note that interchanging drain and source is normally not dangerous to the device tested. In most instances

Cheap heatsink temperature sensor

While there are many accurate temperature sensing ICs available, they are not readily available in packages such as TO-220 which ensure reliable thermal contact for monitoring heatsinks.

This circuit was used as an overtemperature cutout for an intermittently operated inverter that had to be encapsulated.

Q1 is a BD140 connected as a diode and its forward voltage is monitored by the LM393 comparator. The temperature coefficient of the forward voltage is roughly -2.1mV/°C. Q1's forward voltage is compared with a voltage at pin 2, set by trimpot VR1. For reasonable stability of this voltage, the supply voltage should be regulated.



C1 may be necessary if the BD140 has long wires or the environment is electrically noisy as in a switchmode power supply. R1 adjusts the comparator's hysteresis and for most applications doesn't have to be reduced.

G. LaRooy,
Christchurch, NZ. $35)

the FET will function normally. Ceramic capacitor C_F prevents op amp instability or oscillation.

The tester was designed to operate from a 12V DC plugpack to ensure sufficient drain-source voltage but it could be operated from a 9V battery. Comparison tests were carried out with supplies of 12V, 9V and 6V (the end-of-life voltage of a 9V battery) using a random-selected 2N5486 FET. With this range of supply voltage the indicated pinch-off voltage dropped from 3.19 to 3.16V (insignificant) and drain saturation current dropped from 9.7mA to 9.3mA.

Battery operation has one serious disadvantage – from theory of JFET operation, Idss should be tested with the FET's drain-source voltage being at least equal to its pinch-off voltage. For battery operation R3 should be reduced to 470Ω. Minimum supply voltage for the TL071 is specified as ±3.5V but the device used in the prototype did function with a 6V supply.

M. Frankowski,
Warszawa, Poland. ($40)

Single gate oscillator

Normally, at least two gates are needed for an RC oscillator if a Schmitt trigger gate isn't available. This circuit was employed to switch a DC buzzer on and off.

In effect, the circuit runs as a conventional phase shift oscillator with the three time constants providing a 180° phase shift at the operating frequency.

G. LaRooy,
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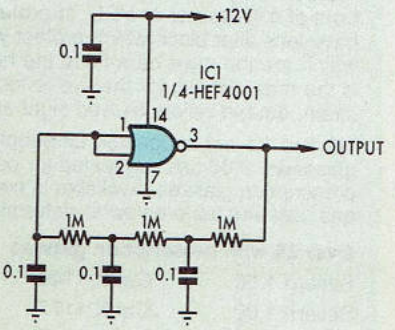

This simple circuit operates as a conventional phase shift oscillator.

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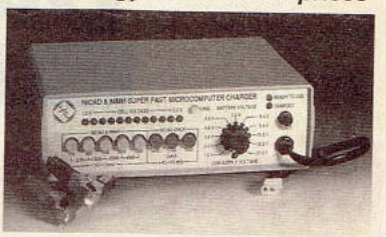

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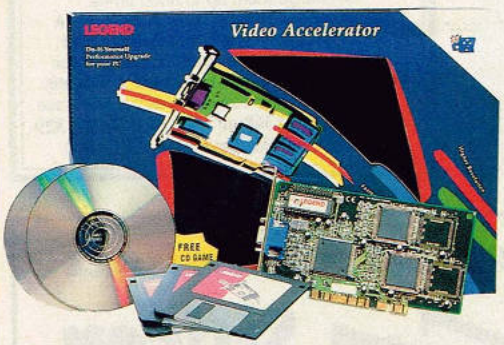

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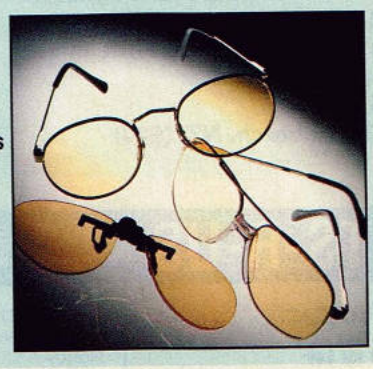

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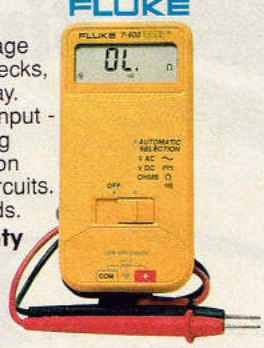

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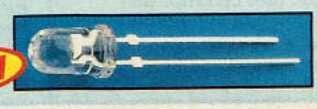

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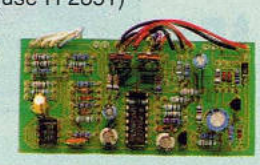

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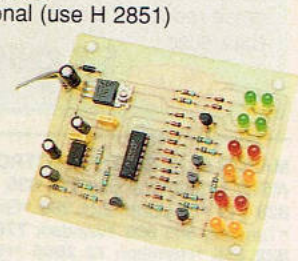

SILICON CHIP May '97

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B 2963

SERVICEMAN'S LOG

The neighbour who made things worse

Why do some people allow friends or neighbours to "have a go" at their VCR or TV when it fails? If their motive is to save money, the ploy usually backfires. More often than not, an amateur serviceman only makes things worse and the job ends up costing more.

My first customer of the morning was Mr Davis who brought in a Sharp VCA34X mid-drive video. He cheerfully admitted he knew nothing about it and informed me that he "was only delivering it for his wife".

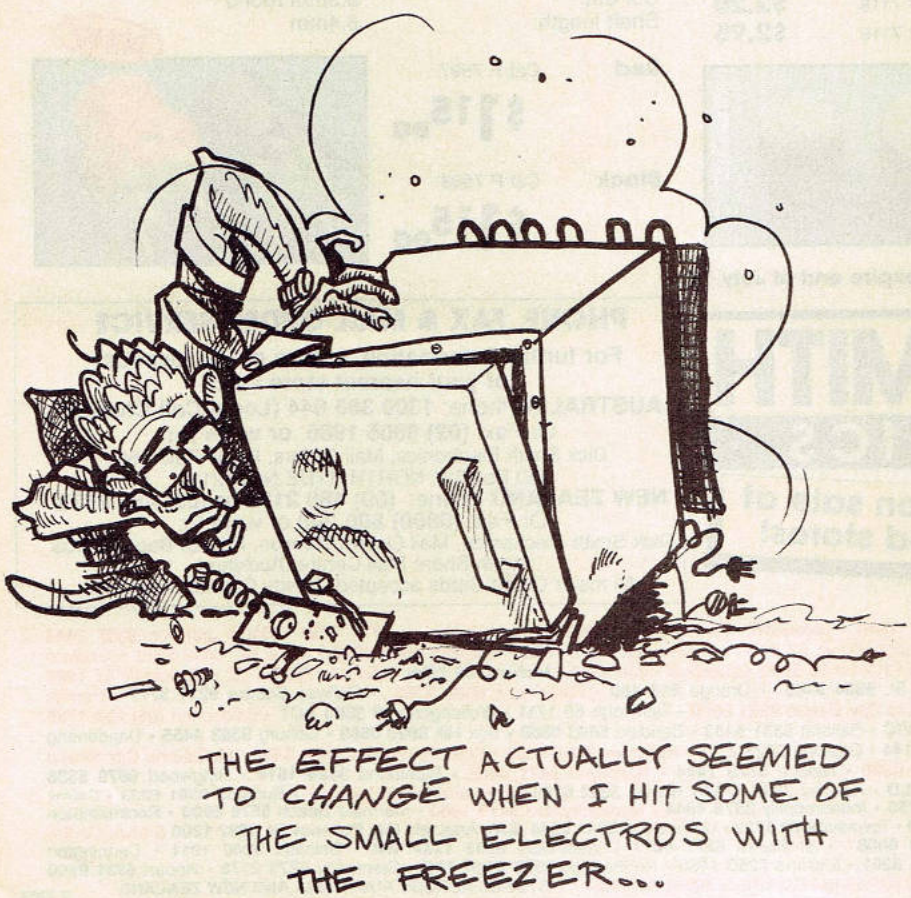
When I turned it on, I noticed that it was patterning severely in playback mode and when the test switch was on. In addition, I was unable to receive any channel in the E-E mode. The patterning was very similar to the symptoms displayed when an electrolytic capacitor has failed in the power supply and the effect actually seemed to change when I hit some of the small electros in this part of the circuit with the freezer.

It seemed initially that one or possibly two electros were susceptible and as I felt sure that I was on the right track, I decided to change them without further ado. In fact, I changed all the electros because if one was faulty, it was possible that the others wouldn't be far behind it.

As it turned out, I was just guessing because changing them made no difference at all. The CRO and multimeter showed that all voltages were clean and correct and so my suspicions now turned to the RF modulator.

To check this, I decided to feed the audio/video outputs from the VCR directly into a monitor. When I played a tape the picture was now clear but there was still no TV channel reception (just snow). It was then that I noticed that when the VCR was switched off, a TV channel appeared quite clearly.

This meant that the TV was tuned into a TV station and that the VCR was transmitting right on top of it. As the output of this VCR is on UHF and can be adjusted easily, I retuned it to approximately Ch.37 and the patterning disappeared completely. It is difficult to comprehend the misleading effects I had in the power supply. Perhaps they were due to the proximity of my hands and arms to the antenna but it's hard to tell sometimes.

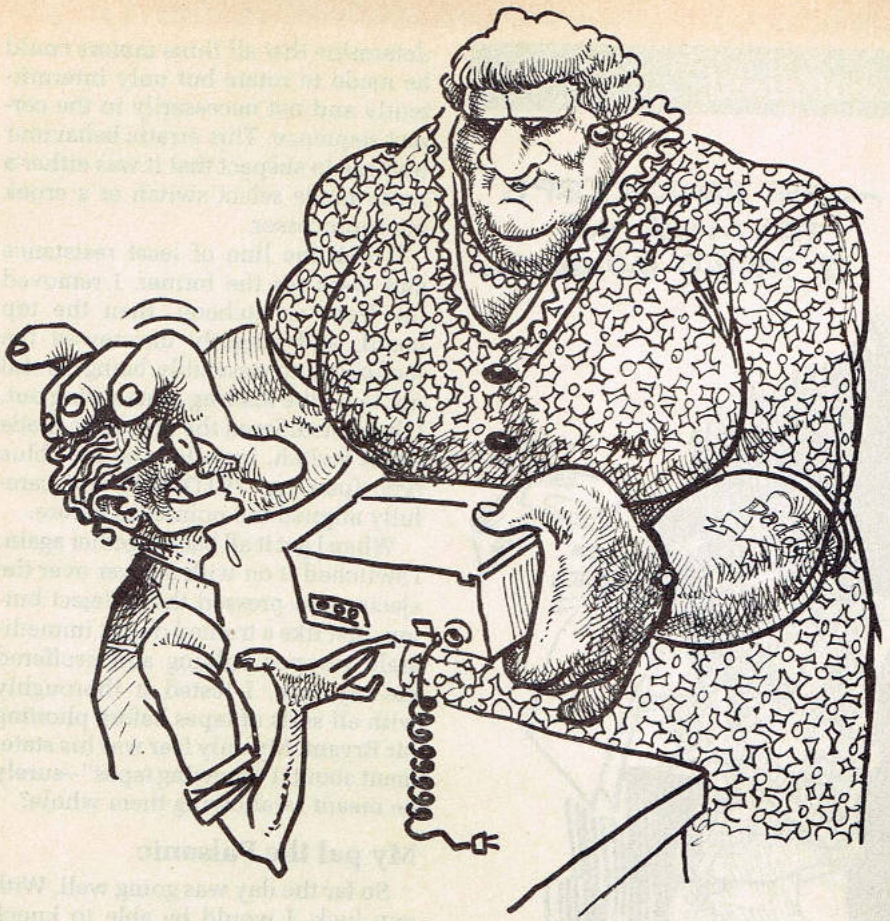


The real complaint

At this stage, I thought that it would be a good idea to talk to Mrs Davis (the VCR's owner), to find out what was really meant to be wrong with the unit. As it turned out, her only complaint was that it was unable to record TV stations. I asked about the patterning on playback but she said she really hadn't noticed it as their reception was pretty poor any way.

Well, at least I now knew what the complaint was. The only thing that couldn't be explained was why the RF output was so far off the factory set Ch.37. Perhaps someone had had a fiddle?

So I now had to address the real



SHE WASN'T NEARLY AS FIERCE AS I IMAGINED HER TO BE...

problem – no TV tuning. To reach the tuner, the top board has to be removed and the bottom board extracted from its well in the plastic case. After gingerly laying out the boards on the bench, I switched it on and measured the voltages to the tuner. All were correct except for the tuning voltage which was permanently stuck on 33V, even when I invoked the tuning mode and sent it searching from band I to band IV. The only changes that occurred were on the band switching rails.

Because I didn't have the correct service manual, I worked from a VCH83/85X manual. This model is a hifi mid-drive unit which is similar to the VCA34X and I found that I could follow the relevant part of the circuit quite easily, the main difference here being circuit reference numbers.

Tracing back the circuit from the tuner, I arrived at the top board and eventually came to Q1401 (2SC1740-SQR) which also had an unchanging 33V on its collector. However, its base voltage was changing as the tuning was adjusted. It was at this stage that I noticed fresh soldering all around the area. Someone had definitely been there before me.

I measured the transistor in circuit and it was fine. I then put the CRO on the base and could see the mark-space ratio of the pulses change in response to the tuning but there was still no change in the collector. The transistor must be lying – there just had to be something wrong with it!

I decided to replace it with a BC547 as I didn't have the original 2SC1740-SQR. It worked – all the stations could now be tuned properly and locked into memory. When Mrs Davis picked it up I asked her if someone had looked at it before. She wasn't nearly as fierce as I had imagined her to be and she graciously admitted that the culprit was her next door neighbour who had also mistuned the RF output.

I put it down to a case of a little knowledge being a dangerous thing.

By the way, out of curiosity, I checked the faulty transistor on my multimeter – it still read perfectly, with no leakage indicated. I then held it up to the light and looked at the legs with a magnifying glass. At last a clue – I could just detect some signs of corrosion where the legs entered the transistor case. My conclusion was that this may have been enough to at least make it intermittent.

Play it again Sam

I was grateful to the Jones family when they decided to bring their Samsung into the workshop because it is a large 68cm stereo TV. Their two sons carried it in from the station wagon and put it on the bench.

I gave it immediate priority so that I could get it out of my cramped workshop, the only problem being that one of the two symptoms described was intermittent. The set was a CB7230WT using an S60MT chassis and apparently it didn't always want to start unless they hit it! And now it had a white line across the screen.

Serves them right for assaulting the poor monster!

Removing the back revealed a flat horizontal chassis divided into two boards. Access was poor due to the usual short connecting leads to the front and because the large reflex cabinets for the speakers got in the way. The lefthand board had the power deflection functions, while the right-hand board carried the small signal circuits.

On switch on, it displayed the classic vertical deflection collapse symptom; ie, a white line across the screen, just as described. It didn't take a mental giant to work out that the 9-pin flat-pack TDA3654 (IC301) attached to a heatsink was the vertical output IC (IC301), especially as it got very hot.

Access to the underside of the board was difficult but manageable once it was unscrewed from its support frame. I fitted a new IC and this cured this fault. Unfortunately, having just fitted the last screw in the back, I found that it wouldn't switch on – not even after I had assaulted it, as well!

There was just the momentary sound of EHT static and then nothing, so out it all came again. With the power board delicately balanced on its side and meter probes at the ready,

I switched it on again and it came on perfectly.

Well, to cut a long story short, I jiggled and poked, bent and hit the boards until finally I established the fault was associated with relay RL801, which switches the 21V and 16V rails. So was it the relay that was at fault or the relay driver circuit?

I traced the line from the relay back towards the driver circuit and eventually came to pin 2 of connector CNP801. It was then that I noticed that the orange 5V lead that goes to pin 1 was not quite properly in its plug receptacle. It didn't take long to fix this and confirm that this was indeed the culprit for the intermittent start-up problem. I tested it frequently until the Jones's gratefully picked their set up later that evening.

The greedy VCR

I had asked Mr Bryant to also bring his remote control and instruction booklet when he brought in his Daewoo-made NEC VN22 VCR and he was as good as his word.

Although he complained that it was "just chewing tapes", it simply swallowed my dummy test tape and alarmingly wouldn't regurgitate it when the eject button was pressed. The only display was a cyclical presentation of all modes. The instruction booklet describes this function indicator as the emergency mode and advises the user to push the reset button. However, pushing this and/or any other button was an exercise in futility.

This sucker wasn't going to give me back my tape whatever I did!

I attacked it with my electric screwdriver and soon had the covers off and then tried to persuade it to give it back. It took me a little while to realise that, with no covers, the end sensors were exposed to incandescent light and this was adding to my woes. Having overcome this problem, I could determine that all three motors could be made to rotate but only intermittently and not necessarily in the correct sequence. This erratic behaviour lead me to suspect that it was either a noisy mode select switch or a crook microprocessor.

I took the line of least resistance and went for the former. I removed the front escutcheon, then the top board, and gingerly unscrewed the loading motor assembly, being careful not to let the loading arms spring out. I then unsoldered the old white mode select switch, installed the new blue type (part no. 79TD3895) and carefully aligned the pointer as before.

When I got it all back together again, I switched it on with a cover over the ejector and pressed the off/eject button. Just like a trained dog, it immediately stopped sulking and proffered me my tape. I tested it thoroughly with all sorts of tapes before phoning Mr Bryant. My only fear was his statement about it "chewing tapes" –surely he meant swallowing them whole?

My pal the Palsonic

So far the day was going well. With any luck, I would be able to knock over two more jobs before the end of the day.

The next in line was a Palsonic 3428 TV set which uses a Goldstar PC04X chassis. The guy who brought this in claimed that he was a technician and that the "electros from the picture tube had caused the fault to occur". I remained unconvinced and I suspected that he had had a go himself and so I was very reluctant to proceed. However, the bank keeps telling me I need money and so I can't turn everything away.

When I switched it on, the set displayed a bright uncontrollable raster which is quite a common symptom for this model. Unfortunately, it has many causes, the most usual being IC501, a Telefunken TDA35622A. For this reason, I have saved the chroma module and also the CRT board from a wrecked set so that I can quickly test these components.

The chroma module comes in two different interchangeable sizes. It is also worth remembering that the heatsink around the power supply will often retain its high voltage for some time after the set has been turned off. A shock from this certainly won't improve your temper as you struggle to

remove this chroma card.

After substitution, the screen control on the tripler often needs realigning to obtain the correct operating point for the tube and it doesn't behave like any other I know. The darkest picture is somewhere in the centre of its range with each end of the control giving a bright raster! What's more, the effect on the picture can vary, with some colours disappearing completely at certain settings.

In this case, the substitute chroma module made no difference, so next I swapped the CRT board. This fixed the problem once the screen control had been adjusted for the darkest picture. OK, so what was wrong with the CRT board from the customer's set.

The circuit (see Fig.1) consists of seven transistors (two for each gun plus a common one), plus three diodes and various resistors and capacitors. Because the overall tint of the white raster was correct, the greyscale was also correct which surely meant that the three amplifiers were working OK, giving even quantities of red, green and blue.

Anyway, I checked the voltages all over the board but could find nothing wrong. Next, I changed the five components that are common to all three driver stages (D901, Q907, C1, R922 and R923) but they made no difference. I disregarded the screen and heater components (C907, C908, R924 and R925) as being too fanciful and there were no cracks in the board or dry joints.

So if it wasn't something common, then perhaps there was some other component failure that was upsetting the whole circuit. What I did discover was that hitting the components with freezer produced a positive result – the raster immediately began to darken and a picture began to emerge. And this could be further improved by finding the correct point with the screen control.

Eventually, after repeated freezing and heating, especially on or around D902, D903 and D904, the picture was completely restored to normal.

At this stage, I put all the old parts back in (except for C1) and carefully checked the diodes and their associated parallel capacitors (C904, C902 & C906) after first removing them from circuit. I couldn't find anything wrong with these parts, so I replaced them and put the set aside to soak test. As it subsequently turned out, it was still behaving normally some two weeks later.

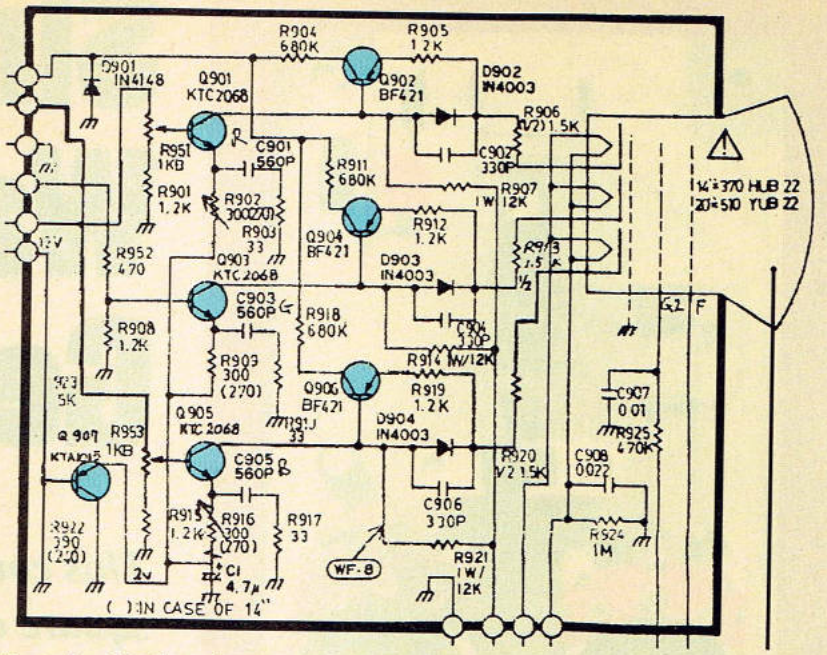


Fig.1: the CRT board circuit for the Palsonic 3428 TV set. It uses seven transistors (two for each gun plus a common one), plus three diodes and various resistors and capacitors

So what caused the problem? My only theory (and I admit that it's rather a lame one) is that one or more of the diodes was internally intermittent and this was affecting the beam current. And this in turn was being shifted well beyond the operating point of the tube so that normal operation was no longer possible.

Or is the explanation much simpler? In all the swapping around of components, have I merely fixed a poor solder joint on the PC board. It is an unsatisfactory result and I invite readers to speculate.

A dead Philips

The last set of the day was a Philips KR66875 2B-S chassis stereo TV which was dead. There was voltage going to the chopper transistor but no B+. I couldn't find any shorts on this rail or to the line output transistor and felt pretty sure that the line output transformer was faulty. To test this, I shorted the base of the line output transistor to its emitter and connected a voltmeter to the collector. On switch on, the collector voltage rose to the full B+ line.

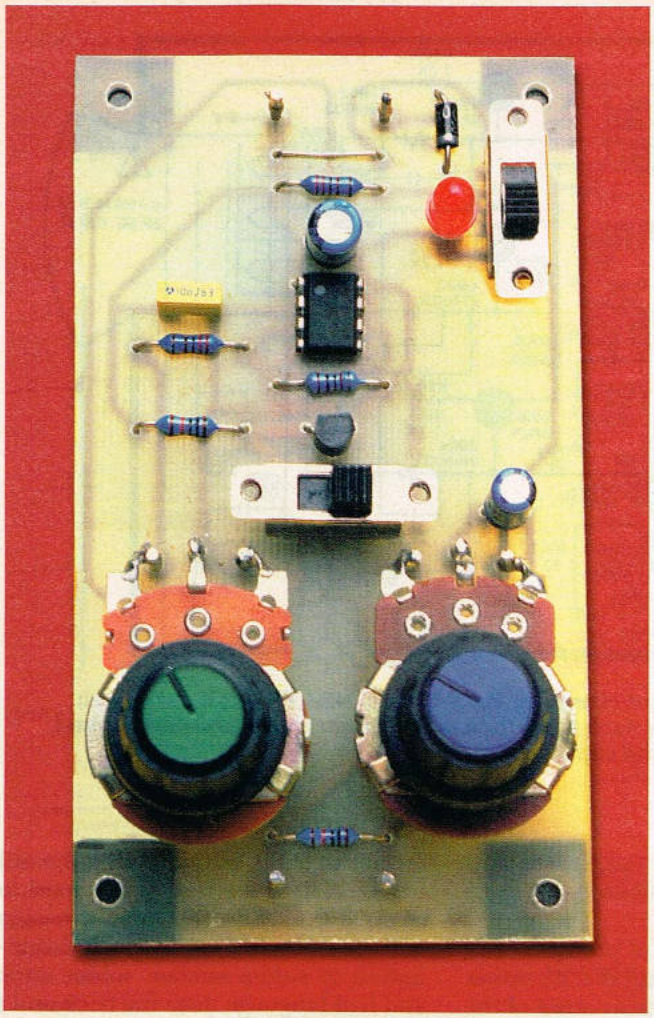
Fortunately, I had a flyback transformer in stock but removing the old one is fairly hairy in that it is hard to remove the solder between the pins and the rivets in the chassis. A combination of solder sucker, solder wick and bad language does the trick and I finally managed to edge the old one out.

The next challenge is to remove the EHT and focus leads which clip into receptacles. These were eased out using side cutters and pushed into their new homes. The new transformer was then installed and, as a precaution, I also replaced the 68µF electro feeding the vertical output IC and soldered a few suspicious looking joints on the main board. I also checked out the memory backup battery.

By the way, access to this set is rather difficult and I find it easier to work with the entire cabinet upside down on a towel rather than trying to find a service position for the chassis. Fortunately, the new flyback transformer did the trick so that was another one knocked over.

Why can't they make TV sets easier to service? Still, I mustn't grumble too much – apart from the Palsonic, the day had gone fairly well. And even then, I managed to get the set fixed, or so it appears.

Only time will tell. **SC**



Simple Waveform Generator

This compact unit produces both square and triangle waves over the frequency range from 100Hz to 20kHz. Build it and use it to test audio amplifiers, filters, tone decoders and digital circuits.

By JOHN CLARKE

A SIMPLE WAVEFORM generator is always useful to have on your workbench. It can be used as a signal source for all sorts of circuits, to test that they are operating correctly. A waveform generator, even a simple unit such as that described here, is particularly useful for troubleshooting or when building circuits from scratch.

This unit lets you select between triangle and square waves and you can vary the frequency output from about 100Hz to 20kHz using a single potentiometer. A second potentiometer lets you vary the output level from 0-10.5V p-p for square waves, or from 0-4V p-p for triangle waves.

All the parts, including the two pots, are mounted on a compact PC board, so that the assembly is really easy. But first, let's find out how it works.

Circuit details

Fig.1 shows the circuit details. As can be seen, it's based on the common 555 timer IC which is wired as an astable oscillator. The timing components are connected to pins 6 & 2 of the IC, with the .01µF capacitor being alternately charged and discharged via VR1 (the frequency control) and its series 2.2kΩ resistor.

The circuit works like this. Initially, when power is first applied, the .01µF timing capacitor is discharged and IC1's pin 3 output is high. The .01µF capacitor now charges via the 2.2kΩ resistor and VR1 until it reaches two-thirds the supply voltage (ie, $^2/_3$Vcc). At this point, an internal comparator connected to pin 6 (the threshold input) of IC1 trips and this switches pin 3 low.

The capacitor now discharges via VR1 and the series 2.2kΩ resistor until it reaches $^1/_3$Vcc (the lower threshold). This point is detected by the trigger input (pin 2), which switches pin 3 high again. Thus, the cycle repeats indefinitely and pin 3 of IC1 alternately switches high and low while ever power is applied.

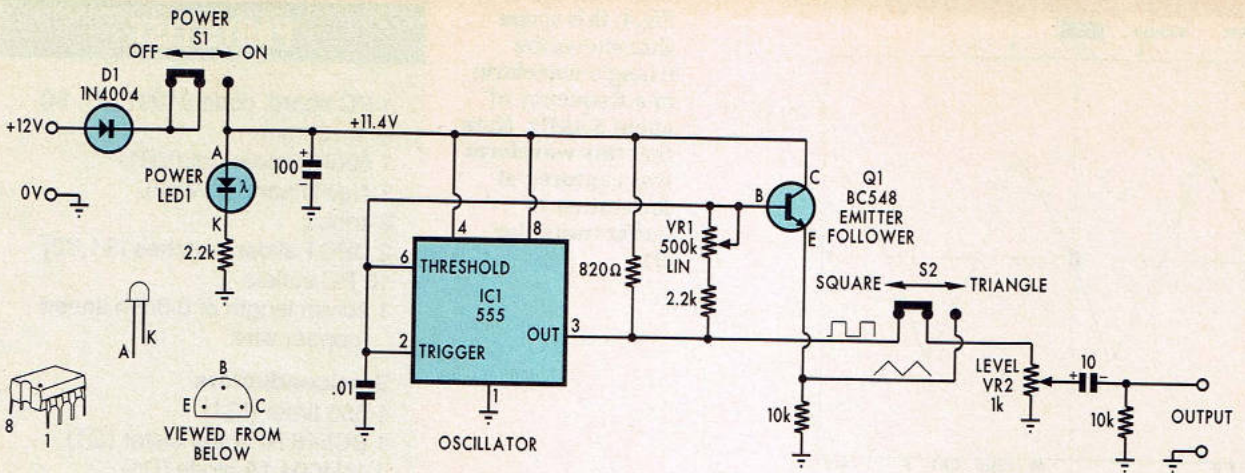
Because it controls the charge/discharge times for the timing capacitor, VR1 effectively sets the frequency of oscillation. The nominal frequency (f) is given by the formula:

$$f = 0.7/R1.C1$$

where R1 is timing resistance and C1 is the timing capacitance. In this case, R1 = VR1 + 2.2kΩ and C1 = .01µF.

These values give a calculated frequency range of 200Hz to 45kHz. However, these figures don't apply in practice because the output of IC1 does not go fully high. An 820Ω pullup resistor is used to pull pin 3 higher than it would otherwise go to give a more symmetrical waveform. However, the resulting frequency range of 100Hz to 20kHz is still less than calculated.

The waveform at pin 3 is a nominal square wave, as shown in Figs.2 & 3. These show the square wave output at 19.7kHz and 122Hz, respectively. The duty cycle is not exactly 1:1 because



SQUARE/TRIANGLE WAVEFORM GENERATOR

Fig.1: the circuit uses a 555 timer IC which is wired as an astable oscillator. Transistor Q1 buffers the triangle output.

of pin 3 not going fully high but is near enough for our purposes.

The waveform on pins 2 & 6 is triangle shaped since it represents the charging cycles of the timing capacitor. This output has a fairly high impedance, particularly at low frequencies when VR1 is above 100kΩ.

Transistor Q1 is used to buffer the triangle waveform. This transistor is wired as an emitter follower, which means that the signal on the emitter follows the signal applied to the base. Fig.4 shows the appearance of the triangle waveform when the frequency is about 5.4kHz.

Switch S2 selects between the square wave at pin 3 of IC1 and the triangle waveform at the emitter of Q1. From there, the signal is fed to level control VR2 and then AC-coupled to the output terminals via a 10µF capacitor. This capacitor ensures that the output signal has no DC component, while the associated 10kΩ resistor ensures that the output is always loaded.

Power for the circuit can be derived from virtually any supply capable of providing between 5V and 15V DC at about 20mA. The most convenient source for this would be a plugpack supply. Diode D1 provides reverse polarity connection protection, while LED1 is the power indicator. A 100µF capacitor decouples the supply to the circuit.

Construction

All the parts for the Waveform Generator are installed on a PC board coded 01307971. Fig.5 shows the wiring details.

Begin the assembly by installing PC stakes at all external wiring points and at the connection points for the

FEATURES

Output waveform	Triangle or square wave
Frequency range	100Hz to 20kHz nominal
Square wave amplitude	0-10.5V p-p (12V supply)
Triangle wave output	0-4V p-p (12V supply)
Power supply	5-15V DC
Protection	Reverse polarity protected
Output impedance	<1kΩ

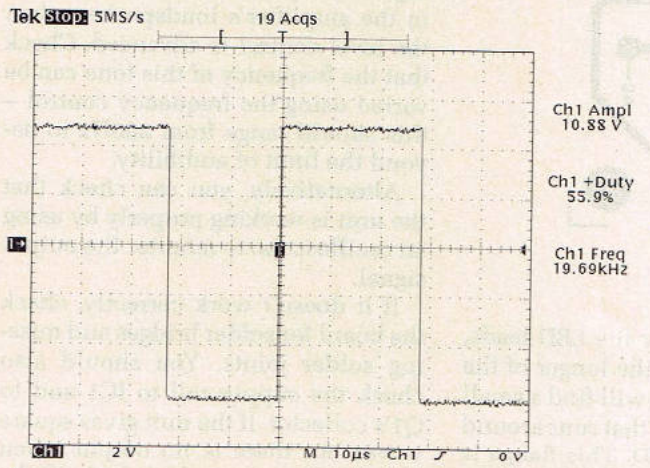


Fig.2: this is the waveform that appears at pin 3 of IC1 when the output frequency is 19.69kHz.

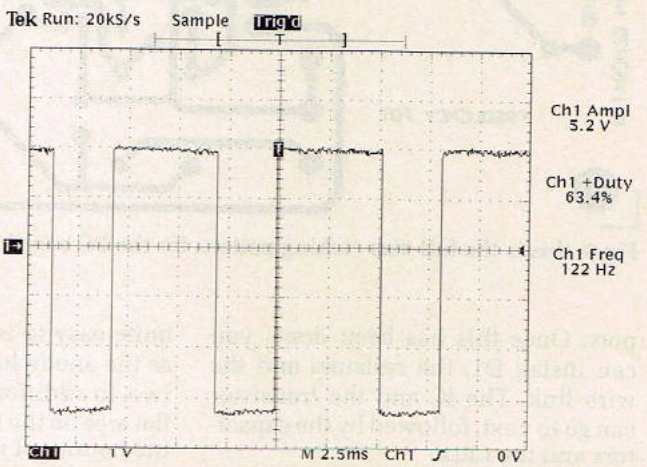


Fig.3: the waveform at pin 3 of IC1 when the output frequency is 122Hz. The duty cycle is not exactly 1:1.

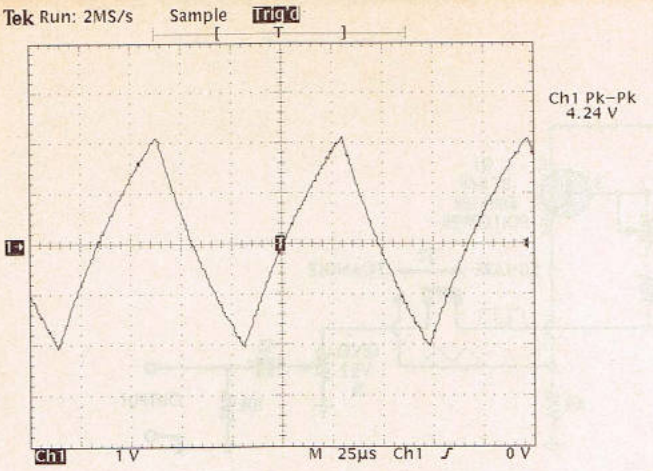


Fig.4: this scope shot shows the triangle waveform at a frequency of about 5.4kHz. Note that this waveform was captured at the emitter of buffer transistor Q1.

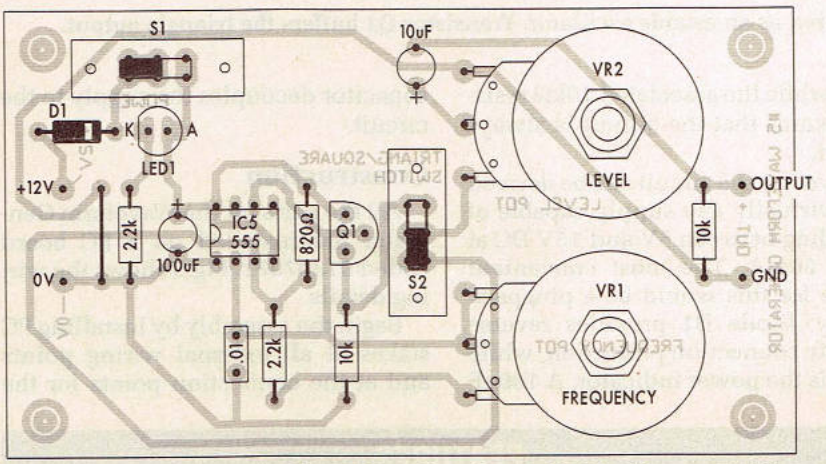


Fig.5: install the parts on the PC board as shown in this diagram. Make sure that all polarised parts are correctly orientated.

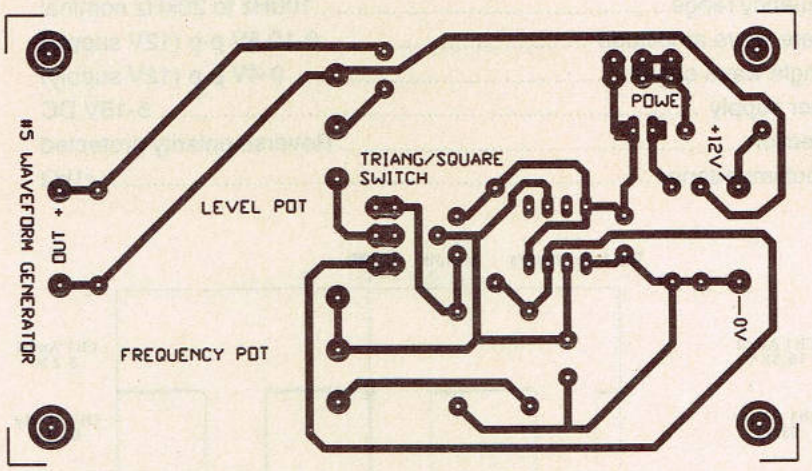


Fig.6: this is the full-size etching pattern for the PC board.

pots. Once this has been done, you can install D1, the resistors and the wire link. The IC and the transistor can go in next, followed by the capacitors and the LED.

Take care to ensure that all polarised parts are correctly orientated. It's quite easy to identify the LED leads, as the anode lead is the longer of the two. In addition, you will find a small flat area on the flange that runs around the bottom of the LED. This flange is always adjacent to the cathode lead.

The two switches are mounted directly on the PC board, while the two pots are mounted by soldering them to their PC stakes. Cut the pot shafts to length before installing them and note that VR1 is a 500kΩ pot, while VR2 is a 1kΩ pot.

Finally, complete the assembly by fitting rubber feet to the corners of the PC board.

PARTS LIST

1 PC board, code 01307971, 60 x 105mm
1 500kΩ linear pot (VR1)
1 1kΩ linear pot (VR2)
2 knobs
2 DPDT slider switches (S1,S2)
10 PC stakes
1 20mm length of 0.8mm tinned copper wire

Semiconductors
1 555 timer (IC1)
1 BC548 NPN transistor (Q1)
1 1N4004 1A diode (D1)
1 5mm red LED (LED1)

Capacitors
1 100µF 16VW PC electrolytic
1 10µF 16VW PC electrolytic
1 .01µF MKT polyester

Resistors (0.25W, 1%)
2 10kΩ 1 820Ω
2 2.2kΩ

Testing

To test the unit, connect the output terminals to an audio amplifier, set the level control fully anticlockwise and apply power. If everything is working correctly, you should hear a tone in the amplifier's loudspeaker when the level control is advanced. Check that the frequency of this tone can be varied using the frequency control – this should range from 200Hz to beyond the limit of audibility.

Alternatively, you can check that the unit is working properly by using an oscilloscope to monitor the output signal.

If it doesn't work correctly, check the board for solder bridges and missing solder joints. You should also check the supply rail to IC1 and to Q1's collector. If the unit gives square waves but there is no output when triangle waves are selected, check the circuit around Q1. SC

Jaycar ELECTRONICS

JULY BARGAINS

Prices valid until 31st July 1997

CCD BOARD CAMERA

New 1997

This 1/3" black and white camera is so small, its simply amazing!! The PC board measures just 32 x 32mm and the camera protrudes from the board about 23mm. This camera allows mounting in extremely small places. To focus simply turn the lens, and the unit requires 12VDC +/-1V. If you are using an AC adaptor plug pack, use a regulated one, as too many volts or reverse polarity will damage the camera. It has a video output which can be connected to a monitor or video in, on your VCR or to a TV through a video modular.

Cat. QC-3460 **Only $139.50**

PANASONIC 1.9AH 12V SEALED LEAD ACID BATTERY

PANASONIC No. LC-TA121R9PU. Another surplus stock purchase. These are used in certain phones, or can be used as a standard SLA battery for burglar alarms, lights etc. Its very easy to solder leads to the battery terminals. Size 181(L) x 23(W) x 60(H)mm. To buy one of these as a replacement, it would cost arround $100. Cat. SB-2482

SAVE A FORTUNE!

New 1997

Limited quantity **These are Only $20 ea**

Weller® PORTASOL GAS SOLDERING IRON

New 1997

Portasol returns!! Portable soldering. The Weller Portasol uses butane gas lighter fuel and is temperature adjustable (equivalent 10-60W). Fills in 20 seconds & has up to 90 mins continuous use fuel capacity. Supplied with cap. Use Jaycar gas - Cat. NA-1020 $5.95. Spare 2.4mm Tip - Cat. TS-1721 $19.95

Cat. TS-1720 **$49.95**

RED HOT POWER SUPPLY DEAL

Amazing surplus stock purchase. GME Electrophone 240V input 12VDC output at a huge 2.2 Amps. Unit is a desk top type, with 240V power lead (length 1.8mt.) and 12V lead (length 1.8mt.) terminated to a 2.5mm DC plug centre positive. Size 130(L) x 90(W) x 65(H)mm.

Cat. MP-3040

These normally sell for $69.95

Only $35 ea

HALOGEN LIGHT SETS

20 WATT LARGE SIZE KIT

New 1997

Includes •20W lamp - 51mm dia. •Downlight holder (white) •Mains t'former, power lead

Cat. SL-2750 **Save $6.90**

Normally $34.85 Kit Only $27.95

50 WATT LARGE SIZE KIT

Includes •50W lamp - 51mm dia. •Downlight holder (white) •Mains transformer, power lead Cat. SL-2752

Save $6.90 Normally $34.85

Kit Only $27.95

20 WATT SMALL SIZE KIT

New 1997

Includes •20W lamp - 35mm dia •Downlight holder (white) •Mains transformer, power lead Cat. SL-2755

Save $6.90 Normally $34.85

Kit Only $27.95

SAVE ON CELLULAR BATTERIES

NOKIA 2010

NI-MH 1200MAH

24 hr. standby, 120 min. talktime.

Cat. SB-2564

Was $45 Save $10

July $35

PHILIPS FIZZ

NI-MH 1800MAH

33 hr. standby, 150 min. talktime.

Cat. SB-2590

Was $69.95 Save $20

July $49.95

RECORDABLE CD'S

SAVE

Quality Mitsubishi brand.

Cat. XC-4710 Was $16.00

Now $12.95 each or 10+ $11.50 each

FREE MAT WITH MOUSE!

Buy our Super Mouse II at $19.95 and receive FREE a Jaycar Mouse Mat worth $4.95

Cat. XM-5110/XM-5095

Only $19.95

CAR SPEAKER SPACERS

New 1997

These spacers are ideal if there simply is not enough room behind car panels to accommodate the speakers. The 6" are 25mm deep and the 6 x 9" is 38mm deep. Both are black in colour. The 6" will fit the following Jaycar car speakers, CS-2258, CS-2262, and CS-2284 and most 6" car speakers. The 6 x 9" will fit the CS-2268 and CS-2290 and most 6 x9' car speakers.

FOR 6" SPEAKERS Cat. AX-3580 **$19.95 pr**

FOR 6x9" SPEAKERS Cat. AX-3584 **$23.95 pr**

REMOTE ANGEL SELLOUT

The best remote See 97 Cat P171.

Cat. AR-1720

Cat. Price $169.50

Save $30

July $139.50

JV110 VIFA 10" SUBWOOFER DEAL

Woofer M26WR-10" Cat. CW-2118 **$229.50**

Cabinet (no baffle) Cat. CS-2552 **$149.00**

Baffle Cat. CS-2556 **$30.00**

Polyswitch RN-3472 **$10.95**

Total $419.45

Save $120.45

July Deal Only $299

12 VOLT 5MM HIGH BRIGHTNESS FLASHING LED

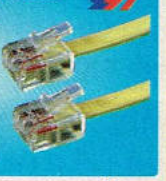
New 1997

Ultrabright 300 mcd 5mm red LED, which is ideal for car alarm deterrent light. No dropping resistor needed. Specifications: •IV (mcd) at 9V - 300mcd •Power dissipation - 200mW •DC forward current - 38-56mA •Reverse voltage - 0.5V

Cat. ZD-1785 **$1.75ea.**

RJ12 MINI LEAD

New 1997



This connects from a US wall socket (or Oz/US adaptor) to a cordless phone or answering machine that is wall mounted. No more dangling cables!!! Length - 150mm - RJ12 plug on each end. **Cat. YT-6044**

ONLY $4.50

SCOOP PURCHASE - 2 LINE 16 CHARACTER LCD DISPLAY

New 1997

Not new - removed from poker machines to make way for more advanced technology. Guaranteed to work as a display but backlight will probably not work. If you want a backlit panel do not buy this unit. All decoder & drivers are on board. You can generate a full upper & lower case alphanumeric display as well as Japanese characters and symbols such as pi, sigma, omega etc. Note, we emphasize that the units are second hand & have been soldered to. They have been removed by professional technicians. 6 x 3mm (approx) character height. Overall display 28W x 72L x 4Hmm.

Cat. ZD-1890 **A Bargain At $9.95**

KEYRING LASER POINTER

New 1997

Keep your laser pointer on your keyring! Incredibly small - measures only 73mm long x 13mm dia. Stainless steel casing, and push button on/off switch. Includes 3 x LR44 batteries. Great low price.

Don't Pay $69

Cat. ST-3102 **Only $59**

LASER POINTER

Don't pay $69 they are only $49 at Jaycar in July SAVE $20 Cat. ST-3100

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ALPS SLIDER POT WITH LED

New CN97

We've made a scoop purchase

LIMITED QTY

of a limited quantity of high quality ALPS brand 5K linear slider pots with an AMBER LED mounted in the slider. Travel is 60mm, and total width of pot is 9mm. These are ideal for graphic equalisers, and they "look a million dollars". Two types are available: WITH CENTRE CLICK Cat. RP-3915 WITHOUT CENTRE CLICK Cat. RP-3916

Only $3.95 each

KNOB TO SUIT Cat HK-7722

50c ea/10+ 30c ea

PLUG PACK BARGAIN

240V to 3, 4.5, 6. 7.5, 9,12VDC at 500mA. Supplied with 7 reversable plugs. Cat. MP-3012

Was $24.95

July $14.95

Save $10.00

C & K SLIDER SWITCH

SPDT PC mount. C & K 1101. Size 12(L) x 6(W)mm. Cat. SS-0815

1-9 Only 75c

10 plus 60c ea

New CN97

CAR DOOR LOCKING

Prices slashed - you won't buy cheaper!

4 DOOR KIT

Cat. LR-8830

Save $20.00

Was $89.00

Now $69

SEPARATE ACTUATORS

MASTER

Cat. LR-8832

Save $8.00

Was $22.95 **Now $14.95**

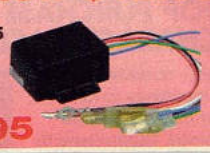
SLAVE

Cat. LR-8833

Save $7.00

Was $19.95 **Now $12.95**

RELAY Cat. LR-8835



Save $10.00

Was $24.95

Now $14.95

LOWER PRICES ON DISKS

Pkt. 25 3.5" HD IBM formatted.

BLACK

Cat. XC-4740

Was $12.95

Now $11.95

Save $1.00

COLOURED Cat. XC-4742

Was $14.95

Now $13.50 Save $1.45

SMOKE ALARM TESTER

NEW

Make sure your family is always protected. Its actually a spray can of smoke! To use simply spray at smoke detector. Easy to use, no dangerous climbing. Enables you to test 3 alarms / month for up to 12 months.

Cat. NA-1025 **Only $3.95**

Jaytech 8 X AA FAST CHARGER DEAL

Buy our Jaytech fast charger in July and receive 6 x 600mA AA Nicads worth $15 Free!! See 97 Cat. P76 for details.

CHARGER Cat. MB-3510

*BATTERIES Cat. SB-2452

Only $39.95

BUY THE CHARGER & GET 6 AA NICADS* FREE

IEC EXTENSION LEAD

New CN97

IEC plug to IEC socket. Length 1mt. Colour grey. Limited quantity.

Cat. PS-4107 **Only $3.95**

IEC SOCKET EMI FILTER

Very limited quantity. Be quick. Filter circuit includes 2 inductors and 3 capacitors. Housed in a metal case. Cat. MS-4005

Only $9.95ea

New CN97

CABLE TIE SPECIAL

New CN97

We've made a surplus stock deal of some Dennison brand 125mm (5") cable ties. They will hold a maximum bundle diameter of 32mm. Save heaps over normal prices!

Pkt. of 100 x 100mm sell for $4.95 Cat. HP-1207

125mm Pkt.100 Only $2.95

PRECISION 5" BOX CUTTERS

Cat. TH-1886

Were $19.95

July $14.95

Save $5.00

PRECISION 5" LONG NOSE PLIERS

Cat. TH-1888

Were $19.95

July $14.95 Save $5.00

MONITOR ANTI GLARE FILTER

Suits 12 - 14" monitors Cat. XC-5150

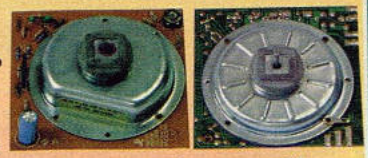
Was $19.95

Now $9.95

Save $10.00

1/2 PRICE

PINING FOR VINYL?



Now is your chance to make the ultimate phono turntable. Yet another scoop purchase. Yes Jaycar has done it again with a distress-stock purchase of a German PAPST toroidal brushless electronic turntable motor. This motor could be the basis for the ultimate home built belt-drive turntable! It can be driven by either AC or DC (16-32V) and is switchable 331/3 or 45RPM. Once speed is adjusted with 2 x10k potentiometers (not supplied) the power source can change by +/-30 odd percent with an almost unmeasureable change in motor speed! The secret is the built-in electronic control circuitry!! These motors were used by a couple of local turntable manufacturers who were into really up market products! Unfortunately they didn't survive the CD onslought. Their loss your gain! Now that vinyl is back in vogue the price of high quality turntables etc. has skyrocketed! This motor was imported from Germany when the Aussie dollar was strong. They still cost over $A150 each in 200+ quantities! They sold here to OEMs for between $200 $ $300. You will not pay anything like this price however!! We only have a limited quantity of these and we are making them available to you at the incredible price of $49.95 each! Full technical specifications with each unit. Please note: In order to build your phono player you will need other items such as: drive belt, small pulley, turntable cabinet etc. None of these are available from us. We can only supply the most difficult component in the equation!!

New CN97

PAPST = GERMAN QUALITY Cat. YM-2700

$49.95 each (LIMIT 2 PER CUSTOMER)

Be early - quantities strictly limited.

2KG SCALES

Measure 1 gram to 2 kg. Metric and imperial. Uses 4AA batteries (not supplied). Cat. QM-7245

Only $49.95

301 PIECE DRILL, BIT & RAWL PLUG KIT

Kit includes: •7 HSS twist drills • 5 woodwork drills •5 masonry drills •1 countersink bit •1 magnetic bit holder •6 screwdriver bits •rawl plugs, plus case. Cat. TD-2425

Was $29.95 Save $9.95

July $20

SAVE $$ ON CELLULAR PHONE CASES

Nokia 232	Cat. HC-6902
Motorola 9000	Cat. HC-6906
NEC P3	Cat. HC-6910
Motorola Flare	Cat. HC-6913

only $10 each

JAYCAR INTRODUCES QUALITY HI FI REPLACEMENT SPEAKERS AT BUDGET PRICES

All drivers are 8Ω and have black paper cones with rubber surrounds and big magnets.

New CN97

Cat. CW-2105	6" 20 WRMS	$17.95
Cat. CW-2110	8" 30 WRMS	$24.95
Cat. CW-2119	10" 40 WRMS	$29.95
Cat. CW-2125	12" 50 WRMS	$39.95

LARGE BLANK WALLPLATE

New CN97

This is a standard power point size white blank wallplate. Size 72 x 115mm. Ideal for many uses, including mounting TV antenna sockets, audio sockets, speaker terminals, low voltage outlets etc, etc.

Cat. LT-3035 **$3.95 ea**

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CANCER FROM MOBILE PHONES!

New 1997

WHY TAKE THE RISK?

There has been much talk lately about the Electromagnetic radiation effects of mobile phones on your head. It seems that some university tests have established a link between 800MHz (mobile phone frequency) radiation and cancer in laboratory rats. Whether this alleged link is applicable to humans is yet to be established. Anecdotal evidence, however, seems to indicate that frequently used mobile phones give many people up to severe headaches, disorientation etc. Jaycar has been searching the world for over 6 months now to find a suitable RF (Faraday) shield to protect the head from radiation yet not compromise the performance of the phone itself.

At last we have come up with a product that does this. The area of greatest radiation concern is around the base of the antenna and around the earpiece ie. where your ear actually presses against the phone. Our product consists of a quality leather case custom made for most popular phones with a LEAD SHIELD sewn into the antenna base/loading coil area and right across the earpiece area. When you put the case over your phone you fashion the cloth protected extremely malleable lead shield around the antenna base. You can test the effectiveness with a meter type microwave oven leakage detector. The difference from unprotected to protected is amazing, yet the signal strength meter on your phone display will show the same levels of signal as an unprotected phone.

Lead shield shown opened. Shield is simply wrapped around the antenna base.

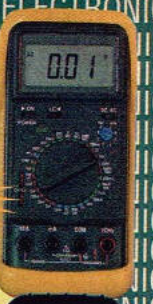
The Jaycar PHONE GUARD protector costs no more than a standard replacement leather case and gives you the comfort of reducing the direct radiation into your head which could be extremely harmful!

This superbly designed case also includes a ROTATABLE BELT CLIP, which easily allows you to turn your phone to the horizontal position, allowing you to sit down comfortably.

Microtac I, II	Cat. HC-6920	**Nokia 1610**	Cat. HC-6932
Motorola 8200,8400	Cat. HC-6922	**Nokia 8110**	Cat. HC-6934
Motorola Flare	Cat. HC-6924	**Ericsson 318/388**	Cat. HC-6938
Motorola 8500,8700	Cat. HC-6926	**Ericsson 738/788**	Cat. HC-6940
Nokia 2100	Cat. HC-6930		

Only $39.95 each

INDUCTANCE DMM



Includes: •Capacitance •Temperature •Transistor test •Continuity buzzer •Diode test •Holster •Carry bag.
See 97 Cat. page 21 for full details.
Cat. QM-1480

AT LAST

Only $99.50

DWELL TACHO DMM

•RPM X 1, X10 •Dwell angle •Resistance •DC volt •Holster included •Great price!!
See 97 Cat. page 22 for full details.
Cat. QM-1440

AT LAST

Only $69.95

PROTEK 506 - COMPUTER CONNECT DMM

•Dual Display •Bargraph •RS232 Interface •True RMS •Auto / Manual •3.75 Digits •4000 Count •Relative Mode •Recording (min, max, avg) •Time Mode •10 Memories •Data Hold •Back Light •Input Warning •10MHz Frequency •Capacitance •20A •Inductance •Temperature •dBM •Logic •Diode •Continuity •Signal Out •Auto Power Off / Keep On Mode •Holster
Cat. QM-1290

Was $289
Save $40

July $249

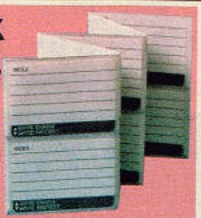
BRAND NEW BOOKS

FULL DETAILS NEXT MONTH

INTRO TO THE WORLD WIDE WEB FOR PC & MAC USERS	BB-7437	$18.95
USING NETSCAPE ON THE INTERNET	BB-7438	$18.95
HOW TO CREATE PAGES FOR THE WEB USING HTML	BB-7436	$16.95
EXPLAINING MICROSOFT PUBLISHER FOR WINDOWS 95	BB-7439	$16.95
306 CIRCUITS	BM-2476	$24.95
ELECTRONIC MODEL RAILWAY PROJECTS	BB-7054	$14.95
AN INTRODUCTION TO SURFACE MOUNT DEVICES	BB-7055	$14.95

3.5" DISK LABELS

New 1997



PACK OF 50
Cat. XC-4782

$4.95

BUY 10 LESS 10%

6.5MM STEREO PANEL SOCKETS

New 1997

Enclosed case, DPST switched, normally closed. Limited quantity available. **Cat. PS-0181**

Only $1.75

JAYCAR WHOLESALE

All Jaycar products are available at very competitive wholesale prices. If you are tired of your current unreliable supplier, why not give Jaycar a try. You'll be pleasantly surprised.

TELESCOPIC MIC FLOOR STAND

Adjustable from 900 to 1600mm.
See 97 Cat. page 169 for details.
Cat. AM-4140

Was $59.95

July $49.95

Save $10.00

240V TO 115V STEPDOWN TRANSFORMER

Stepdown transformer to run 115V USA mains equipment in Australia. Limited quantity available. Cat. MF-1092

Was $79.95 Save $30

Only $49.95

CHECK YOUR PULSE RATE

Measures from your finger tip. See 97 Cat. page 178 for full details.
Cat. QM-7256

Normally $34.95

July $20

Save $14.95

NEW BULKHEAD PLASTIC CASE

This is a bit larger than the current one we stock. Size 110(L) x 66(W) x 36(D)mm. Supplied with plastic lid which holds in with 4 screws and it has a mount on each end for fixing. Colour black. Bulk users-contact our Wholesale Dept for bulk prices.

New 1997

Cat. HB-6080

$3.95ea

SAVE OVER 25% ON METAL SPEAKER GRILLS

Size	Was	Now	Save	Cat.
8"	$10.95	$7.95	$3.00	AX-3520
10"	$13.95	$9.95	$4.00	AX-3522
12"	$16.95	$11.95	$5.00	AX-3524
15"	$19.95	$13.95	$6.00	AX-3526

UNIDIRECTIONAL PROFESSIONAL DYNAMIC MICROPHONE

•Low impedence •Excellent reproduction of voice and music •Zinc diecast case •Convert to balanced mic with Canon lead. See 97 Cat. page 168 for full details.
Cat. AM-4094

Was $49.95 **July $39.95** **Save $10**

MINI TOWER CASE POWER SWITCH

New 1997

SPDT push button switch for tower case.
Cat. SP-0746

$6.95

JAYCAR ELECTRONICS JAYCAR

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

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TOROIDAL BARGAIN

We have 40 pieces only of a UK made ILP multitapped toroidal transformer. The 4 output voltages are: 8.5VAC, 18VAC, 20VAC and 20VAC. Total current rating would be about 100 - 120VA. **The quantity is so small, they are only available from the mail order department.** Size 90mm dia. x 40mm high. **LIMITED QTY**

Cat. MT-2100 **Only $20 each**

1000MA 0.45V EXPERIMENTORS SOLAR PANEL

Connect in series or parallel. Size 95 x 65mm.

Cat. ZM-9004 **Cat Price $7.50**

July Only $5 ea Save $2.50

SCART LEAD

Scart plug to scart plug - length 1.5mts.

Cat. AV-6550 Was $9.95

July $5.00

POKER / BLACKJACK GAME

Just like the real poker card machines in Clubs, Pubs etc. •Can bet high or low •Double up as many times as you like •Bet from $1 to $100 per bet BLACKJACK - JUST LIKE THE REAL CASINO'S •Can split •Can have insurance like the dealer •If you have never played Blackjack this game will teach you how to play. Bet from $1 to $100 per bet.

Cat. QM-7360 **Was $17.95**

July $12.95 **Save $5.00**

AM/FM POCKET RADIO

Pocket radio - size 61 (W) x 99 (H) x 190mm. Ideal for pockets.

Cat. AR-2220

Cat Price $17.95

July $12.95

Save $5.00

FAMOUS JV60 SPEAKER KIT

Jaycar Vifa

Save hundreds of dollars over equivalent built speakers. Easy to assemble, and they sound magnificant. Call into any store for a demo.

JV60 COME UP TRUMPS

Recently the Audio Society of WA had a "Great Speaker Comparison". The speakers compared were: •Vandersteen 2C $3,800 •KEF 103/4 $3,700 •Whatmough 202 $1,900 •Vifa JV60 $849.

The winner by a huge majority was the JV60's!!! Craig Balmer (President) said "Excellent on all types of music. I do not know of any other speakers that offer the same value for money!"

JULY BONUS

20mts. of super flat OFC cable with every complete set. Value $99.00

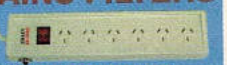
SPEAKER & CROSSOVER Cat. CS-2560 $579pr

PREBUILT CABINETS Cat. CS-2562 $299pr

$878pr COMPLETE SET $849pr Save $29

6 WAY MAINS FILTERS

Cat. MS-4030 **$32.95**



STANDARD BOARD

Cat. MS-4035 **$44.95** WITH PHONE LINE PROTECTION

240V TO 115V 100 WATT

Stepdown for US devices to run on Australian voltage.

Cat. MF-1091

Only $49.95

CLOCK MOVEMENT

Make your own clock, or fix your old broken clock. Cat. XC-0100 **$9.95**

FOOT SWITCH

Momentary action - either push-on or push-off. 250V 10A.

Cat. SP-0760 **$15.95**

JC 30 COMPACT SPEAKER KIT

Crossovers shown are representative only

REFER EA FEB. 97 This speaker kit came about because we purchased a quantity of high quality cabinets from a woodwork factory who had made them for a speaker manufacturer who went broke. We purchased the cabinets at a fraction of their build cost and designed the speaker kit around them. The cabinets are extremely high quality. They are made from 19mm MDF board which is covered in an unfinished Jarrah wood veneer and needs to be stained and/or lacquered. There is a small amount of construction work required to complete the cabinets and this is reflected in the low price of the kit. Specifically this work is: rear port hole needs to be slightly enlarged, speaker grills need to be built from 4 pieces of pre-cut hardwood beading supplied and grill cloth needs mounting. These jobs should not pose much of a problem to those with a modest level of woodworking skills. The fundamental quality of the enclosures will make the effort worthwhile. THE SPEAKER KIT - the woofer used are our Re/Sponse Carbon Fibre Drivers and the tweeters are Vifa D19. The crossovers are pre built. The total impedence is 4Ω, which is not a problem for most amplifiers and they could even be used in a car stereo system. Power handling is 80WRMS.

SPEAKER KIT Includes: •2 x 6" carbon fibre woofers •2 x Vifa D19 dome tweeters •2 x pre built crossover networks.

Cat. CS-2590 **$229 Pr**

CABINETS Includes: •2 x pre built cabinets •Grill frame pieces •Speaker cloth •Rear terminals •Innerbond •Ports •Speaker grill clips •Wire.

Jarrah Cat. CS-2592 **$169 Pr**

Normally $398 Pr

BUY SPEAKER KIT & CABINET KIT TOGETHER

Pay Only $349 Pr

Quote from Rob Evans - Elec Aust: At an all up kit price of just $349 a pair, these new two-way kit speakers from Jaycar may well represent about the best value-for-money around in high performance bookshelf loudspeakers.

RESPONSE SPLIT CAR SPEAKERS

They just keep on winning! In a recent test in Hot 4's, our 4" speakers beat Clarion, JBL, Sanyo, Pheonix Gold, Coustic and Kenwood. Quote from Hot 4"s "We honestly did'nt think you could get a pair of speakers this good for under $100 pair, and we recon they could probably take on speakers triple the price"

All include adjustable angle tweeters.

4"	Cat. CS-2280	$49.50ea
5"	Cat. CS-2282	$59.50ea
6"	Cat. CS-2284	$59.50ea
6.5"	Cat. CS-2288	$69.50ea
6x9"	Cat. CS-2290	$79.50ea

Adjustable tweeter

AUDIO ACCESSORY SELLOUT

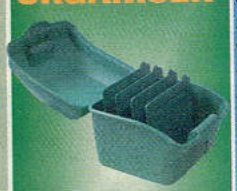
All products are in extremely small quantities. Not all products are in all stores. Not available at dealers. Stock cannot be shipped between stores. Grab them while they last. For full details see our Sept 96 ads.

DESCRIPTION	CAT.	SEPT 96 PRICE	NOW
Camcorder accessory bracket	AV-7000	$14.95	$2.00
6V 20W video light	AV-7003	$29.95	$10.00
3 metre scart to scart lead	AV-7011	$22.95	$5.00
VHS-C head cleaner tape/fluid	AV-7012	$9.95	$2.00
Video battery multi changer	AV-7019	$29.95	$10.00
Video shoulder strap	AV-7026	$7.95	$2.00
8mm dry head cleaner tape	AV-7027	$7.95	$2.00
8mm wet head cleaner tape	AV-7038	$9.95	$2.50
Cassette demagnetiser/cleaner	AV-7042	$2.00	$0.50
15W video light bracket	AV-7046	$24.95	$10.00
Scart to 5 pin DIN + 2 BNC lead	AV-7050	$8.95	$2.00

SAVE $$$ ON RECHARGEABLE BATTERIES

TYPE	CAT.	WAS $	JULY $	SAVE
1.1AH AA Ni-Mh	SB-2455	4.95	4.00	0.95
1.1AH AA Ni-Mh with solder tags	SB-2457	5.25	4.30	0.95
800mA AA Nicad	SB-2450	3.50	2.50	1.00
1.3AH C Nicad	SB-2459	4.95	3.95	1.00
9 Volt 100mA	SB-2458	12.95	9.95	3.00
Sub C 1.3AH	SB-2456	4.95	3.95	1.00

PHOTO FILE ORGANISER



Holds up to 600 photos.

Cat. HB-5200

Retail Price $29.95

Cat. Price $14.95

July Only $10

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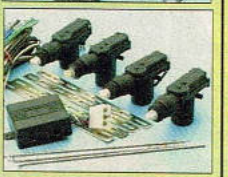
CAR ALARM DEALS - AMERICAN LEGEND / EQUATOR

American Legend Car Alarm



Features learning remotes: See 1997 catalogue page 73.
Deal 1: Buy the alarm at $139.50 and pay only $10 extra for the siren. (LA-8908)
Total $149.50 Save $15.95
Deal 2: Buy the alarm at $139.50 and pay only $30 extra for the battery back up siren.
Total $169.50 Save $29.95
Deal 3: Buy the alarm and battery back up siren and 4 door central door locking for only **$249** and save **$39.50.**

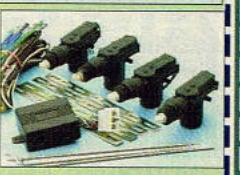
ALARM	$139.50	LA-8912
SIREN	$60.00	LA-8910
LOCKING	$89.00	LR-8830

Normally **$288.50**
$249 and save **$39.50**

LA-8908 LA-8910

Equator Car Alarms

See cat for full details



EQUATOR LA-8902
Deal 1: Buy the alarm at $169 and pay only $10 extra for the siren. (Siren LA-8908) **Total $179.00 Save $15.95**
Deal 2: Buy the alarm at $169 and pay only $30 extra for the battery back up siren (Siren LA-8910).
Total $199.00 Save $29.95
Deal 3: Buy the alarm and battery back up siren and 4 door central door locking for $269 and save $48
ALARM: $169.00 SIREN: $60.00 LOCKING: $89.00 **Normally $318**
Total $269 Save $48

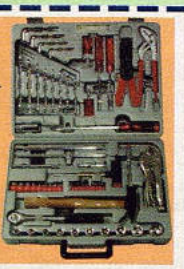
EQUATOR LA-8905
Deal 1: Buy the alarm at $229 and pay only $10 extra for the siren. (Siren LA-8908) **Total $239.00 Save $15.95**
Deal 2: Buy the alarm at $229 and pay only $30 extra for the battery back up siren (Siren LA-8910).
Total $259.00 Save $29.95
Deal 3: Buy the alarm and back up battery siren and 4 door central door locking for only $329 and save $49.
ALARM LA-8905: $229 SIREN LA-8910: $60 LOCKING LR-8830: $89
Normally $378 Total $329 Save $49

LA-8908 LA-8910

40 PIECE TOOL KIT

See 1997 Cat. P99 for full list. Cat. TD-2100
Was $24.95
July $19.95
Save $5.00

100 PIECE TOOL KIT



See 1997 Cat. P99 for full list. Cat. TD-2102
Was $49.95
July $39.95
Save $10.00

BOTH INCLUDE BONUS TYRE PRESSURE GUAGE

JV100 10" 3 WAY 5 SPEAKER KIT

Jaycar Vifa

See 1996 Catalogue page 47 for full details.

NORMALLY		
Speaker kit	*Cat. CS-2550*	*$1,199 Pr*
Cabinets	*Cat. CS-2552*	*$378 Pr*
		$1577 Pr

July buy together $999pr Save $500

Quote from Leo Simpson - Silicon Chip on JV100's
"This speaker really performs, with prodigious power handling and beautiful bass down to below 30Hz. But as well as power handling and extended bass response, the system is very satisfying in its handling of all types of music with a smooth midrange and very clean treble reproduction."

SAVE $20 ON "HEARTFIT"

High performance heart rate monitor. See 1997 Cat. page 178 for full deails. Cat. QM-7240
Was $99.95
July $79.95
Save $20

Jaycar ELECTRONICS

10 PC SCREW DRIVER SET

Supplied in case - includes 4 Phillips and 6 slotted screwdrivers.Cat. TD-2015
Was $19.95 Save $5
July $14.95

REMOTE POWER-UP KIT FOR PC'S

REF: EA JUNE 1997
Dial a remote computer and retrieve files. Can also be used to turn on mains appliances. Kit is complete with modem-style case, front panel label, PCB, transformer plus all electronic components. Software available from the Electronics Aust. bulletin board.
Cat. KA-1794 **$49.95**

SPEAKER GRILL CLOTH

Black in colour.
Size 1.5 x 1M. Cat. CF-2752
Normally $16.50
July $12.50
Save $4.00

SPEAKER CARPET

Cover PA bins & car subs.
Black in colour. Size 1 x1.8m.
Cat. CF-2755 ***July $32.95***

"JAYBOND" SPEAKER DAMPENING MATERIAL

White one side, grey the other. Size 700mm x 1m.
Cat. AX-3690
$6.95

The "Full House" Power Driver Bit Set

New in 97

All the weirdo driver bits in one go!! -The set consists of 32, of the driver bits that you don't normally see. You don't get any slotted, Phillips or Posidrive bits.
You do get: •4 x Tri - wing, size 1, 2, 3, and 4 •9 x Torx (tamperproof), size T8, T10, T15, T20, T25, T27, T30 and T35 •4 x Pin drive (snake), size 4, 6, 8 and10 •6 x In - Hex (allen), *metric, size 2, 2.5, 3, 4, 5 and 6 •6 x In - Hex (allen), *imperial size 5/64", 3/32", 7/64", 1/8", 9/64" and 5/32" •3 x Torque Set, size 8, 9 and 10. With this you get a hex driver with magnetic retainer, all in a nifty plasticy - rubber holder that is smaller than a deck of cards! (67 x 45 x 30mm). you will never get stopped by a wacko screw ever again!!

Cat. TD-2035 **Was $29.95 Save $8.00**
NEW LOW PRICE $21.95

CELLULAR PHONE / VIDEO CAMERA / 12V / 240V/ AAA / AA / NI-CAD / NI-MH BATT. DISCHARGER / DEEP CONDITIONER CHARGER

Supplied with charging plate for Motorola Microtac battery. Adaptors for other batteries available at extra costs. See list. See 97 Cat. on page 77 for full details.

VIDEO CAMERA BATTERY ADAPTORS:
- Sharp, Hitachi, Sony **Cat MB-3565**
- Panasonic, Canon, JVC **Cat MB-3566**

AA / AAA BATTERY ADAPTORS:
- AA x 6 **Cat MB-3570**
- AAA x 6 **Cat MB-3572**

ALL ADAPTORS
$12.95 each

ADAPTORS FOR OTHER BATTERIES:
•Motorola Microtac: Supplied with charger •Motorola 8000/9000/9800 7.2V Cat MB-3555 **•NEC P3/P300 6.0V** Cat MB-3556 **•NEC P388/P4/P6/P400/P600/P601** Cat MB-3574 **•Ericsson 237/337 6.0V** Cat MB-3557 **•Ericsson 197/198/172/818 Cat** MB-3576 **•Oki 700 6.0V** Cat MB-3558 **•Nokia 2110 6.0V** Cat MB-3559 **•Nokia 101/121** Cat MB-3560

CHARGER INCLUDES:
- Power supply (240V to 12VDC 1A)
- Cigarette lighter lead.
- Motorola Microtac adaptor.

CHARGER Cat. MB-3550
Only $69.95

RS232 MINI PATCH BOX

Make custom interface. D25 *male/female.*
Cat. PA-0880
Was $6.95
July $4.95
Save $2.00

ETHERNET LAN CARD

Cat. XC-4650
Cat. Price $69.95
Save $15.00
July $54.95

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LCD "VERNIER" TYPE ENGINEERS CALIPERS

Stainless steel, digital readout, 0 - 150mm range. See 1997 Cat. page 106 for details.

Cat. TD-2082 **Only $99.95**

COMPUTER MICROPHONE HEADSET

Lightweight, with adjustable mic. boom. Weighs only 65 grams. See 1997 Cat. page 160 for details.

Cat. AA-2028 **Only $19.95**

PA DRIVER AND HORN COMBO

Attention PA Enthusiasts

SCOOP PURCHASE

We have purchased a quantity of Motorola KSN1142 piezo drivers together with the Sammi SH-350 professional horn. If you require audience penetrating projection, together with huge power, this fantastic combo will compliment any two way speaker bin. •Horn type: exponential •Horn cut off:600Hz •ABS resin •Dispersion: 120x90° •Throat dia: 24mm •318Wx198Hx211Dmm •Piezo power: 400WRMS •Freq resp: 1.8K to 20kHz. Three year warranty on driver. Last year if you purchased the 2 individually you would of paid $144 **Cat. CT-1930** LIMITED QUANTITY AVAILABLE

ONLY $89 SAVE $55

SPEAKER/MICROWAVE BRACKET

Mount heavy speakers, TV or a microwave on a wall with this bracket. Has adjustable depth from 375 to 570mm, wall bracket length is 420mm maximum width. Will handle 31kgs and colour is black.

Cat. CW-2820 **Only $24.95**

HEAVY DUTY CABLE CUTTERS

8" long and cuts thick cable. Cat. TH-1898

Was $14.95 Save $5

July $9.95

UNIVERSAL SCREW ASSORTMENT

This pack contains 20 sizes of the most popular screws used in VCR's, CD players, amplifiers etc. Each screw has a head with a Pozidrive/Philips driver slot. 10 pieces of each screw provided. 200 pieces in all.

Cat. HP-0102

Was $12.95

July $7.95

Save $5.00

TURN YOUR SURPLUS STOCK INTO CASH!

Jaycar buys surplus/distress stock of most electronic products from components to built products. If you have marketable quantities of stock you need to clear contact Bruce Routley or Mark Ostro on

Phone: 02 9743 5222

Fax: 02 9743 2066

SOLDERING IRON STAND

Cat. TS-1500

Was $10.95

July $7.95 Save $3.

5V IN 110VAC OUT LOW POWER INVERTER

As removed from equipment by competent professional techs. These potted units measuring 18mm wide x 17mm high by 24mm long will accept a 5VDC input to produce a high voltage (low current) AC display for fluorescent back lighting for electroluminescent panels etc.The 110V can be rectified & filtered (if necessary) for a low current high voltage 130VDC supply as well. Ideal for experimenters! Includes wiring diagram. NOTE: Second hand but guaranteed to work. **Cat. MI-5010**

$3.95ea or 10 for $20

POCKET SHIFTER MULTITOOL

Includes •Shifter with 18mm jaw opening •Phillips head screw driver •Slotted screwdriver •File •Canopener •Bottle opener •Knife •Supplied with holder and belt clip •Made in Taiwan.

Cat. TH-1905 **Was $19.95**

July $14.95 Save $5.00

12V WIND UP EXTENSION REEL

The cable length is 4 metres. The reel has two cigarette lighter sockets for powering equipment. Current 10A.

Cat. PP-2016

Was $12.95

July $8.95

Save $4.00

NEW KIT

ADD-ON REGULATOR KIT FOR 12V BATTERY CHARGERS

Refer: Electronics Australia July 1997. This simple kit converts a 'bare bones' automotive battery charger into a fully regulated charger that can be left connected to the battery indefinitely. Once the battery reaches a pre-determined voltage, the charger is switched on and off to maintain that value indefinately. Kit is supplied with PCB plus all specified electronic components.

CHARGER & CLIPS NOT INCLUDED

Cat. KA-1795 **Only $22.95**

Jaytech 6 SECTOR HOME BURGLAR ALARM DEAL

Save a fortune by buying our ALARM DEAL NO 1 using the Jaytech 4500 panel. Includes all the components needed to give you a quality basic home alarm system. All you need is a bit of labour and you have a reliable affordable alarm that offers you peace of mind. Please note, panel has blue facia.

PROTECT YOUR HOME FOR UNDER $200!

INCLUDES:	NORMAL PRICE
1 x 6 sector Jaytech panel	$109.50
2 x Micron pulse count PIRs	$59.90
1 x mains power supply	$21.50
2 x reed/magnet switches	$11.50
1 x siren horn	$25.95
2 x deterrent stickers	$4.00
50 m of 4 core alarm cable	$28.00
NORMALLY PAY	$260.35

Cat. LA-5450 **$199**

DSC 5 Sector Alarm Deal

This system includes the DSC 5 sector alarm panel with Austel Approved dialler. Connect it to an alarm company or it can phone you or your neighbours etc.

THE BEST DSC Security Products

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This alarm clock will mount on a wall! It will also stand up by itself on a table. It features large digits, snooze feature, it illuminates at the touch of a button and is 12 or 24 hour format.

Bracket supplied with double sided tape for mounting on wall, window, car etc etc.

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This alarm has a built-in passive infra red (PIR) detector and 100dB piezo screamer. It can be mounted on a wall, or sit on a bookshelf. It's 9 volt battery operated (battery not included), or from 240V with an optional adaptor - use Cat. MP-3006 $15.50. Unit size: 137(H) x 80(W) x 53(D)mm. Ideal alarm for home units, garages, caravans, boats, office etc. Scoop Purchase We have purchased these as distress stock & can offer at a much reduced price to what they are currently selling for.

Cat. LA-5150

Normally Around $79
Then Sold For $49.95
July Now Only $39.95

BONUS With each LA-5150 purchase select either a Vibration Door Alarm Chime Cat. LA-5170 or a Window Door Magnetic Alarm Cat. LA-5165 - **FREE**

TELKO PROGRAMMABLE ENTRY ALARM / CHIME

This unit simply mounts on a door or window & can be used for two purposes: 1) Mount it on the front door of a shop, or office. It sounds a pleasant chime. 2) Mount it on a door and the siren will sound if its opened. Supplied with clear instructions. Requires 3 x AAA alkaline batteries (not supplied). Uses magnetic sensor switch for contacts. Size: 132(H) x 80(W) x 28(D)mm. **Cat. LA-5160**

NORMALLY $49.50
Only $24.95

TELKO WINDOW / DOOR MAGNETIC SENSOR ALARM

This small alarm is designed to be mounted on a window or door. Its very compact and has an on/off switch on the body. Size: 64(H) x 32(W) x 20(D)mm. Colour-white. **Cat. LA-5165**

Normally $19.95 Only $9.95ea

TELKO VIBRATION DOOR CHIME AND ALARM

This unit simply hangs on the door knob inside a room. When the door is opened or shaken it will "sound". The chime setting is good for doctors, dentists, offices etc. In the alarm mode, there is a piercing alarm sound. Operates from a 9V battery (not supplied).

Cat. LA-5170

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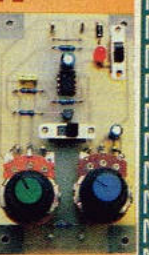

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POINT CONTROLLER KIT FOR MODEL RAILWAYS

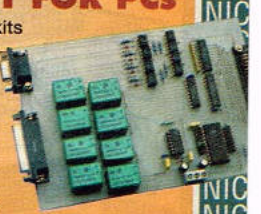
REFER: SILICON CHIP JULY 1997
This kit prevents you burning out model railway solenoid assemblies by ensuring that only a short voltage pulse is applied to operate the solenoids as opposed to an accidentally long pulse when operated manually by hand. An excellent low-cost addition to any model railway layout. Kit includes PCB plus electronic components. Cat. KC-5229

$9.95

I/O CONTROLLER CARD KIT FOR PCs

REFER: SILICON CHIP JULY 1997 Eight of these card kits can be daisy chained and connected to one parallel port on your PC. They can be individually addressed, or coded with the same address in a master-slave setup. Each card can monitor eight input lines as well as switch eight on-board relays. Control home appliances, alarm systems, commercial appliances, home lighting, watering systems - you can totally automate your home! The Jaycar kit includes PCB, 8 x SY4066 relays, on-board connectors plus all specified elec components.

Cat. KC-5230



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SCOOP PURCHASE OF THE DECADE

BUY YOURSELF A PUNCH IN THE KIDNEYS

IF YOU THOUGHT SUB-WOOFERS WERE LOW - WAIT FOR THIS!!!

AURA INTERACTOR

The "AURA INTERACTOR" is a device that you strap to your body to give an extra dimension to listening to Hi Fi, watching a video, experiencing a computer simulation or game or playing a video game etc. What is this extra dimension? You strap this thing on you and experience - through your body - the punches and kicks from martial arts games, explosions and subsonic roar through home cinema or TV games, tackles, slam dunks etc. The heart of the system is a substantial electromagnetic transducer which is like a speaker but without a cone (see box). The transducer is mounted inside a rigid plastic enclosure which straps on to you just like a back pack. A lead from the back pack connects to a filter/amplifier.

The filter/amp then connects to your program source which could be:

- **TV or VCR**
- **Laser Disc Player**
- **CD Player**
- **Walkman**
- **Video Game Console**
- **Hand Held Game**
- **Computer Sound Card**

In fact any audio source which you know has some low frequency information.

The special amp not only filters out extraneous audio, a frequency shifter will divide the frequency of the bass signals by four to intensify the effects of the pulsations. The amp is rated at 21 watts RMS which might not sound like much but has a 70 watt peak rating which is more meaningful as it only operates when it needs to!

A comprehensive range of adaptor leads and plugs are supplied which includes specific adaptors for:

- **Super Nintendo**
- **Sega Genesis I**
- **Sega Genesis II**
- **Some Computer Sound Cards**
- **Walkmans**
- **Many other amplifiers, video players etc.**

Other standard (ie. part of Jaycars range) plug adaptors and leads will almost guarantee compatibility with your source material. A substantial 30VA power supply is also included.

THIS IS AN EXPERIMENTERS DELIGHT:

Not only is the AURA INTERACTOR distress stock buy a wonderful opportunity to get some subsonic transducers at a bargain price. You also get a brand-new one channel amplifier that will deliver about 20 watts RMS into 4 ohms. This amp has special filters that can be used to make it into a subwoofer amplifier. They can be bypassed of course!

Not only that a massive plug pack transformer is also included. It gives 2 x 11.5V AC @ 1.25A. This is ideal for a ±12V 1.25 Amp power supply! Very handy! Quite frankly there is well over $50 value in this deal.

THE ELECTROMAGNETIC TRANSDUCER:

This unit is the device that delivers the low frequency information into the small of your back to give you the "feel" of real explosions, kicks, tackles, sonic booms etc. It operates like a loudspeker in that it has a voice coil and magnet assembly. It has no cone, however. In its place is a heavy steel mass that transmits a jolt by the inertia of the mass. (The mass stays still and the frame moves or sometimes vice versa). We were aware that such devices exist because they are fitted into the seats of some really up market movie theatres. Such electromagnetic actuators are so expensive that they are beyond the budget of most electronics enthusiasts.

If you want to experiment with subsonic effects for home cinema etc this is a wonderful opportunity to get some transducers at a reasonable price. Sure you will have to buy the whole unit but they would cost well over $50 on their own anyway!

Specifications for the Subsonic Actuator:

- Operating frequency: Subsonic
- Maximum force: 20 foot pounds
- Rated power: 18 watts continuous RMS
- Dimensions: 250(W) x 300(H)mm
- Nominal force: 0.5 foot pounds per watt
- Voice coil impedance: 4 ohms
- Weight: 1.5kgs

Cat. XC-1000

CONTACT US FOR BULK QUANTITY PRICING!

The AURA INTERACTOR was a fairly good seller in the USA but was just too expensive out here at around $269 retail. This made it an accessory that cost more than the games it operated from. Once again Jaycar has made a massive scoop purchase of an entire shipment. The goods are brand new and guaranteed free of defects of any kind for three months after the date of sale.

Our fabulous distress stock buy enables you to secure one of these units for the very modest price of $49.95! we only have a limited number of these so be early!

WAS $249

Supplied with a complete set of leads and adaptors

ONLY $49.95

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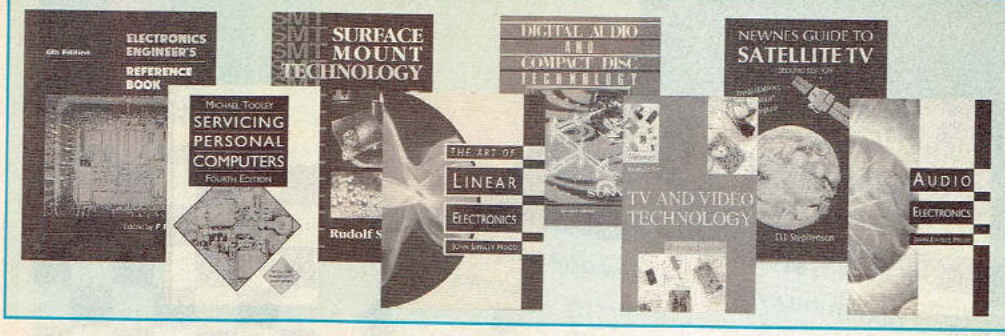

Newnes Guide to Satellite TV

Installation, Reception & Repair. By Derek J. Stephenson. First published 1991, reprinted 1994 (3rd edition).

This is a practical guide on the installation and servicing of satellite television equipment. The coverage of the subject is extensive, without excessive theory or mathematics. 371 pages, in hard cover at $55.95.

Guide to TV & Video Technology

By Eugene Trundle. First published 1988. Second edition 1996.

Eugene Trundle has written for many years in *Television* magazine and his latest book is right up date on TV and video technology. 382 pages, in paperback, at $39.95.

Servicing Personal Computers

By Michael Tooley. First published 1985. 4th edition 1994.

Computers are prone to failure from a number of common causes & some that are not so common. This book sets out the principles & practice of computer servicing (including disc drives, printers & monitors), describes some of the latest software diagnostic routines & includes program listings. 387 pages in hard cover at $59.95.

The Art of Linear Electronics

By John Linsley Hood. Published 1993.

This is a practical handbook from one of the world's most prolific audio designers, with many of his designs having been published in English technical magazines over the years. A great many practical circuits are featured – a must for anyone interested in audio design. 336 pages, in paperback at $49.95.

Digital Audio & Compact Disc Technology

Produced by the Sony Service Centre (Europe). 3rd edition, published 1995.

Prepared by Sony's technical staff, this is the best book on compact disc technology that we have ever come across. It covers digital audio in depth, including PCM adapters, the Video8 PCM format and R-DAT. If you want to understand digital audio, you need this reference book. 305 pages, in paperback at $55.95.

Power Electronics Handbook

Components, Circuits & Applications, by F. F. Mazda. Published 1990.

Previously a neglected field, power electronics has come into its own, particularly in the areas of traction and electric vehicles. F. F. Mazda is an acknowledged authority on the subject and he writes mainly on the many uses of thyristors & Triacs in single and three phase circuits. 417 pages, in soft cover at $59.95.

Electronics Engineer's Reference Book

Hard cover version now available

Edited by F. F. Mazda. First published 1989. 6th edition.

This just has to be the best reference book available for electronics engineers. Provides expert coverage of all aspects of electronics in five parts: techniques, physical phenomena, material & components, electronic design, and applications. The sixth edition has been expanded to include chapters on surface mount technology, hardware & software design, semicustom electronics & data communications. 63 chapters, in hard cover at $120.00.

Radio Frequency Transistors

Principles & Practical Applications. By Norm Dye & Helge Granberg. Published 1993.

This book strips away the mysteries of RF circuit design. Written by two Motorola engineers, it looks at RF transistor fundamentals before moving on to specific design examples; eg, amplifiers, oscillators and pulsed power systems. Also included are chapters on filtering, impedance matching & CAD. 235 pages, in hard cover at $85.00.

Surface Mount Technology

By Rudolph Strauss. First published 1994.

This book will provide informative reading for anyone considering the assembly of PC boards with surface mounted devices. Includes chapters on wave soldering, reflow soldering, component placement, cleaning & quality control. 361 pages, in hard cover at $99.00.

Audio Electronics

By John Linsley Hood. Published 1995.

This book is for anyone involved in designing, adapting and using analog and digital audio equipment. Covers tape recording, tuners & radio receivers, preamplifiers, voltage amplifiers, power amplifiers, the compact disc & digital audio, test & measurement, loudspeaker crossover systems and power supplies. 351 pages, in soft cover at $52.95.

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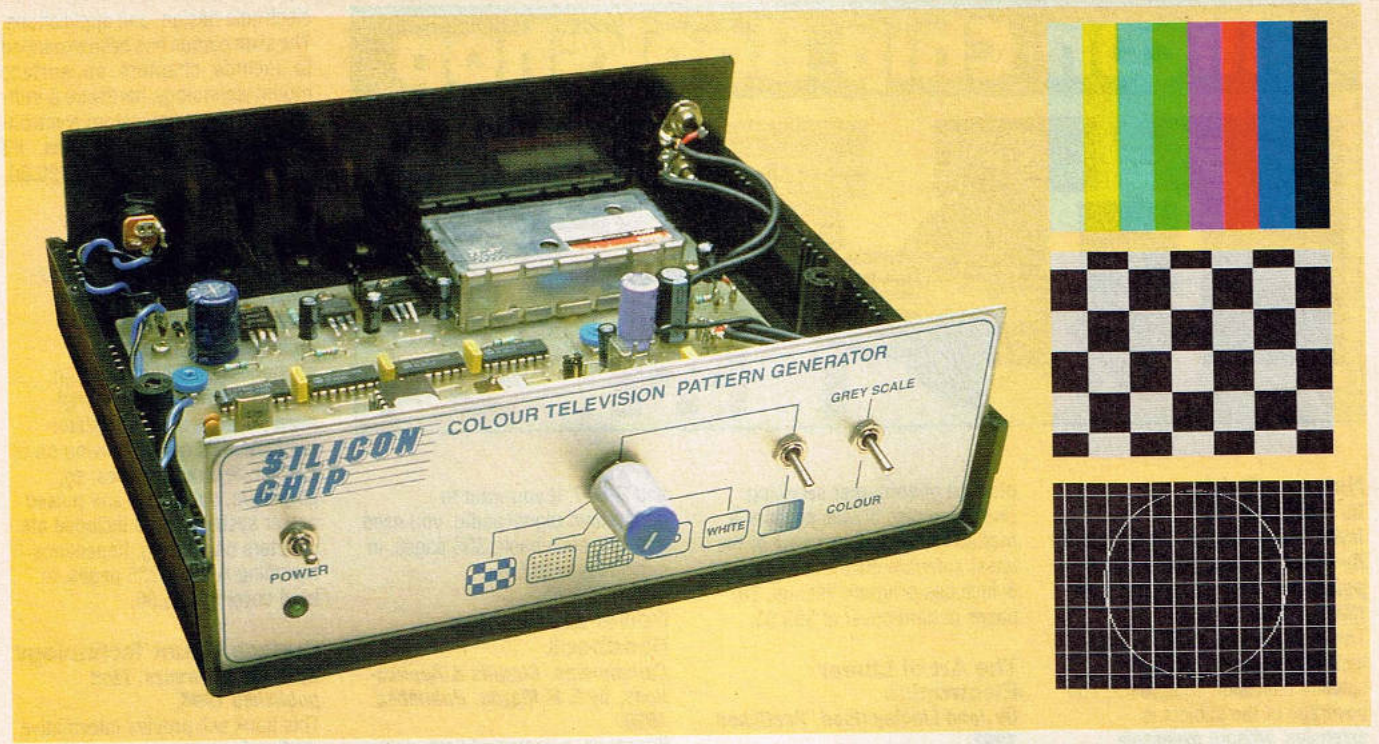


Colour TV pattern generator; Pt.2

While the Colour Television Pattern Generator is rather complex in its operation, the circuitry is straightforward. This is because all the patterns are stored in the ROM. This month, we present the circuit and give the construction and testing details.

By JOHN CLARKE

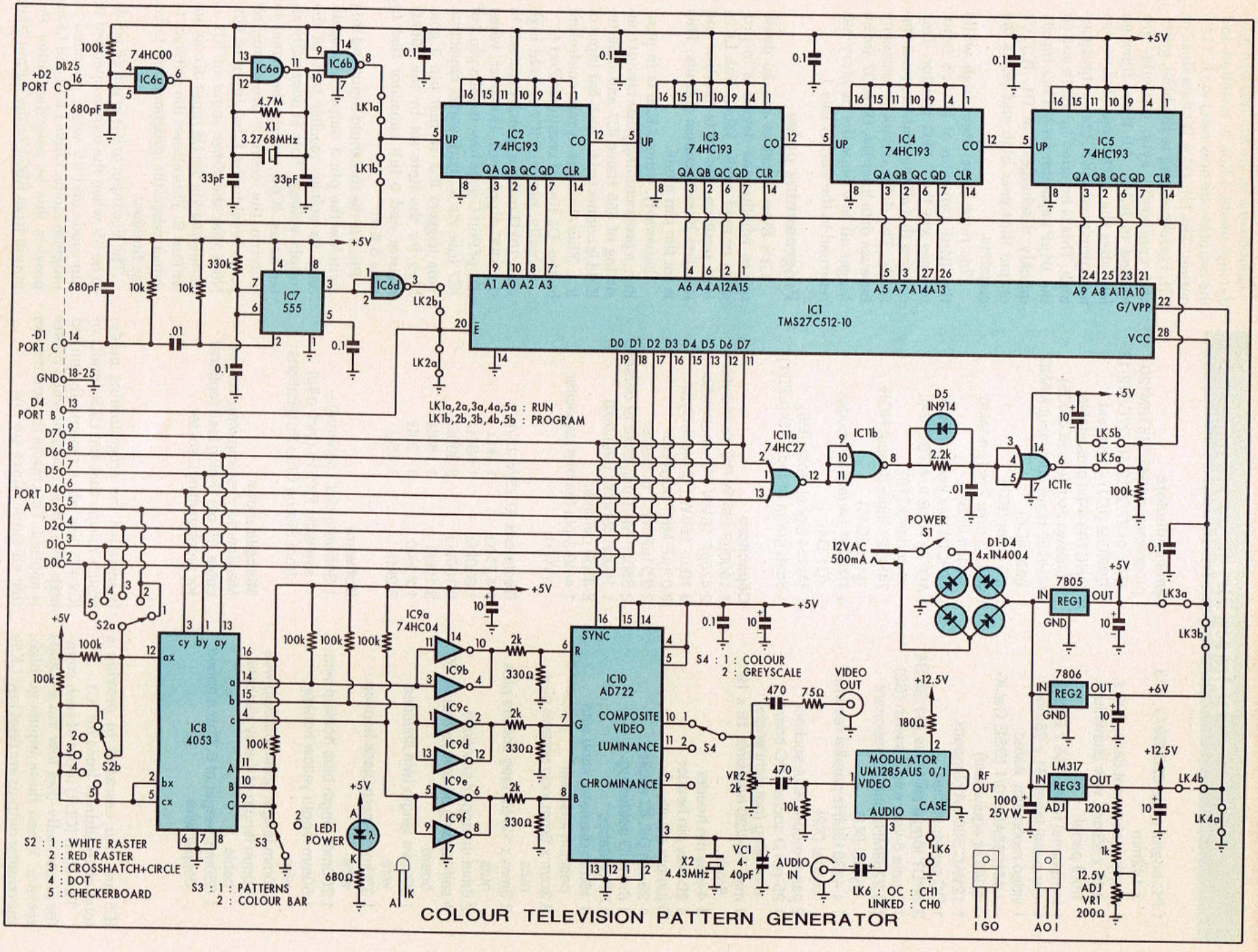
The circuit for the Colour Television Pattern Generator is shown in Fig.9 and comprises 11 ICs in total. Central to the circuit is IC1 which is the 64K EPROM or OTP memory (note: this device was incorrectly referred to in Pt.1 as an EEPROM). This IC has its address lines connected to counters IC2, IC3, IC4 & IC5.

Counter IC2 is driven by a clock signal from either IC6b or IC6c, depending on the link (LK1a or LK1b) connection. With LK1a in position (run mode), counter IC2 is clocked by a 3.2768MHz oscillator based on IC6a, with IC6b serving as a buffer stage. Note that pin 13 of IC6a is tied high while its pin 12 input is connected to its pin 11 output via a 4.7MΩ resistor. This biases the gate in the linear mode so that it operates as an inverting amplifier. The 33pF capacitors to ground on either side of crystal X1 provide the correct loading.

LK1b is substituted for the program mode, in which case IC2 is clocked via inverter stage IC6c from the D2 line on Port C of the computer. The 100kΩ pullup resistor connected to IC6c's inputs prevents them from floating when Port C is disconnected, while the associated 680pF capacitor provides transient suppression. This prevents false clocking which could otherwise occur whenever there are level changes in the data lines on Port A.

IC2 is an up/down pressettable synchronous 4-bit counter with a carry out (CO) output at pin 12. This output is fed to the clock input of the following counter (IC3), which is connected in cascade with IC2. IC4 &

Fig.9 (right): the complete circuit diagram of the pattern generator. All the patterns are stored in the EPROM (IC1) and this is programmed via the parallel port of a PC.



COLOUR TELEVISION PATTERN GENERATOR

PARTS LIST

1 PC board, code 02305971, 173 x 142mm
1 plastic instrument case, 200 x 155 x 65mm, with aluminium front panel
1 front panel label, 195 x 63mm
1 rear panel label, 31 x 25mm
1 video modulator, Astec UM1285AUS 0/1 (DSE Cat K-6043 or equivalent)
1 12VAC 500mA plugpack
1 DC power socket
3 SPDT toggle switches (S1,S3,S4)
1 2-pole 6-way rotary switch (S2)
1 3.2768MHz parallel resonant crystal (X1)
1 4.433619MHz parallel resonant crystal (X2)
2 panel-mount RCA sockets
1 25-pin D socket, PC board mounting (not right angle)
1 mini TO-220 heatsink, 19 x 19 x 9mm
1 4-way pin header
1 20-way pin header
5 jumper shunts
1 28-pin DIL IC socket
1 8mm ID solder lug
17 PC stakes
1 15mm diameter knob with position indicator
3 3mm x 6mm long screws plus nuts
2 3mm x 12mm long screws plus nuts
2 6mm untapped standoffs
4 self-tapping screws to mount PC board
1 200mm length twin shielded wire
1 350mm length black hookup wire
1 200mm length blue hookup wire
1 50mm length yellow hookup wire
1 50mm length green hookup wire
1 60mm length of 4-way rainbow cable
1 650mm length of 0.71mm tinned copper wire

Semiconductors
1 programmed NM27C512N120 OTP or 27C512-10, 27C512-12 EPROM (IC1) – see text
4 74HC193 4-bit presettable up/down counters (IC2-IC5)
1 74HC00 quad dual input NAND gate (IC6)
1 555 timer (IC7)
1 4053 3-pole 2-way analog switch (IC8)
1 74HC04 hex inverter (IC9)
1 AD722 RGB to NTSC/PAL encoder (IC10)
1 74HC27 triple 3-input NOR gate (IC11)
4 1N4004 1A rectifier diodes (D1-D4)
1 1N914 signal diode (D5)
1 3mm green or red LED (LED1)

Capacitors
1 1000µF 25VW PC electrolytic
2 470µF 16VW PC electrolytic
8 10µF 16VW PC electrolytic
8 0.1µF MKT polyester
2 0.01µF MKT polyseter
2 680pF MKT polyester or ceramic
1 100pF ceramic (see text)
2 33pF ceramic
1 4-40 3-pin trimmer capacitor (VC1)

Resistors (0.25W, 1%)

1 4.7MΩ	1 1kΩ
1 330kΩ	1 680Ω
8 100kΩ	3 330Ω
3 10kΩ	1 180Ω
1 2.2kΩ	1 120Ω
3 2kΩ	1 75Ω

Software
1 Software disc (optional) – available for $10 (incl. p&p) from Silicon Chip Publications

Miscellaneous
Medium-duty hookup wire, rainbow cable, 25-pin D-plug lead (optional for programming), solder.

IC5 are also cascaded to provide a total of 16 address lines for IC1.

The clear (CLR) input of each counter is normally tied low via a 100kΩ resistor. When these inputs go high, the counter outputs are reset low. LK5b is installed for programming mode, which means that the CLR inputs of IC2-IC5 are all momentarily pulled high via a 10µF capacitor when power is applied. This resets the counters so that all output lines are low.

Conversely, in the run (pattern producing) mode, LK5a is installed and the counters are now reset via IC11c's output. The D4, D5 & D7 data lines of IC1, corresponding to the blue, green and composite sync outputs, are NORed in IC11a. All these lines go low after the 312th line of data has been produced and IC11a's output goes high. This is inverted by IC11b and so the .01µF capacitor on IC11c's inputs quickly discharges via D1. IC11c's output thus goes high and resets the counters.

This reset signal stays high while the .01µF capacitor at IC11c's input charges via the 2.2kΩ resistor. This ensures that all the counters reset correctly. The delay circuit is necessary because data lines D4, D5 & D7 are no longer all low once the memory has returned to the start of line 1.

Programming pulse

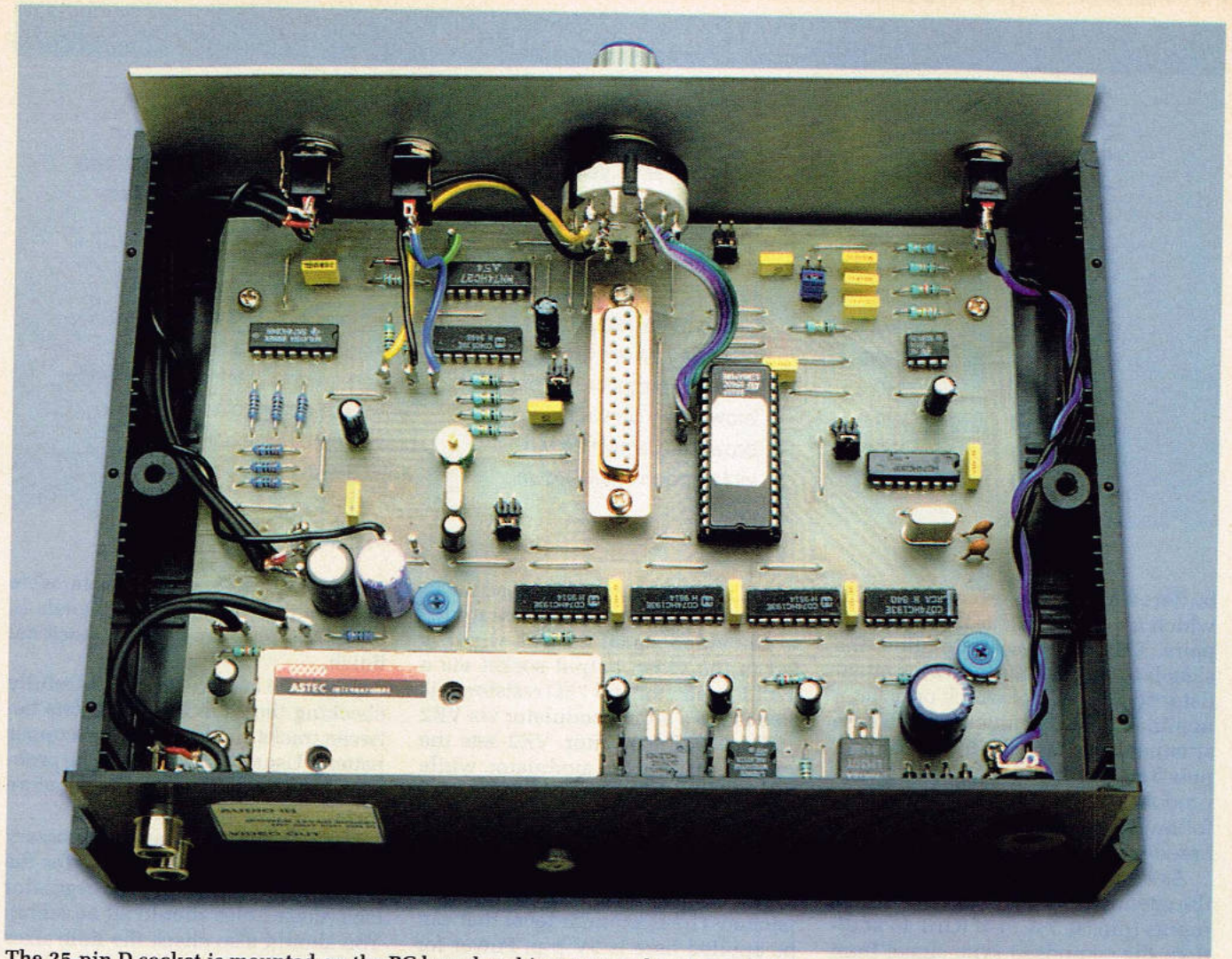
IC1's E-bar input at pin 20 determines whether the device is in program or read mode. When link LK2a is in position, pin 20 is tied low and the data lines becomes outputs. This is for the run mode.

Conversely, when LK2b is in position, a programming pulse circuit consisting of 555 timer IC7 and inverter IC6d is connected to the E-bar input of IC1. This circuit is in turn controlled by the -D1 line of computer Port C.

Initially, pin 2 of IC7 is held high via a 10kΩ resistor which connects to the +5V supply rail. However, when -D1 of Port C goes low, it pulls pin 2 of IC7 low via a .01µF series capacitor. This triggers IC7 so that pin 3 goes high for the time set by the 330kΩ resistor and 0.1µF capacitor tied to pins 6 & 7.

Pin 6 is the threshold input and this switches the pin 3 output low again once its voltage reaches 66% of the supply voltage. This is nominally after 33ms. IC6d inverts the signal to provide the correct programming pulse level to the E-bar input of IC1. Note that the E-bar input of IC1 is monitored via the D4 input of computer Port B. This allows the software to detect when the programming pulse has finished.

The Vcc input to IC1 at pin 28 needs to be 5V when the unit is operated in run mode and 6V when operated in program mode. Links LK3a and LK3b provide this by selecting either the output from REG1 or the output from



The 25-pin D socket is mounted on the PC board and is connected to the parallel port of the computer to program the EPROM. Once programming has been completed, the unit operates independently of the computer.

REG2 respectively. Similarly, the G/Vpp input at pin 22 requires 12.5V for programming but 0V when outputting the data. This is achieved using links LK4a and LK4b. LK4b selects the 12.5V output from regulator REG3, while LK4b connects the G/Vpp pin to ground.

The circuit is powered from a 12VAC plugpack via switch S1. Diodes D1-D4 rectify this and the resulting DC is filtered using a 1000µF capacitor. REG1, REG2 and REG3 regulate the voltage down to 5V, 6V and 12.5V respectively.

REG1 and REG2 are standard 3-terminal regulators which provide 5V and 6V rails, respectively. The 10µF capacitors at their outputs are there to prevent instability and provide improved transient response. LED1 is connected across the 5V supply via a 680Ω resistor to give power-on indication.

REG3 is an adjustable regulator which produces a nominal 1.25V between its adjust and output terminals. The 120Ω resistor across these terminals sets up a current of around 10mA which flows through the 1kΩ resistor and 200Ω variable resistor VR1. VR1 is adjusted to set the output voltage to 12.5V.

Rotary switch S2a selects between the checkerboard, dot, crosshatch/circle and raster patterns available at the D0-D3 outputs of IC1. The selection is applied to the ax input (pin 12) of IC8, a 4053 CMOS analog switch.

Input ax is the red signal for the selected pattern, while the bx and cx inputs (pins 2 & 5) are for the green and blue signals. The latter are normally connected to the ax input via switch S2b, except for position 2 when the red raster is selected. In that case, the green and blue inputs are tied high via a common 100kΩ resistor.

IC8 basically behaves as a 3-pole 2-position switch. The a, b & c outputs at pins 14, 15 & 4 respectively are the three poles. The ax, bx and cx connections are switched through when the A, B and C control lines at pins 11, 10 & 9 are low and this occurs when switch S3 is in position 1. Depending on the position of S2, this provides the signals for either the white raster, the red raster, crosshatch/circle, dot or checkerboard pattern.

Conversely, when S3 is open, the A, B and C inputs are pulled high via a 100kΩ resistor and the alternative ay, by & cy inputs (pins 13, 1 & 3) are switched through instead. This provides the colour bar pattern from the D6, D5 & D4 data lines of IC1.

RGB-to-PAL encoding

The a, b and c outputs of IC8 are

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	4.7MΩ	yellow violet green brown	yellow violet black yellow brown
1	330kΩ	orange orange yellow brown	orange orange black orange brown
8	100kΩ	brown black yellow brown	brown black black orange brown
3	10kΩ	brown black orange brown	brown black black red brown
1	2.2kΩ	red red red brown	red red black brown brown
3	2kΩ	red black red brown	red black black brown brown
1	1kΩ	brown black red brown	brown black black brown brown
1	680Ω	blue grey brown brown	blue grey black black brown
3	330Ω	orange orange brown brown	orange orange black black brown
1	180Ω	brown grey brown brown	brown grey black black brown
1	120Ω	brown red brown brown	brown red black black brown
1	75Ω	violet green black brown	violet green black gold brown

buffered using inverters IC9a-IC9f which are connected as three parallel pairs. This is necessary to allow the signals to be fed to the following attenuator stages, each of which only has a nominal 2.33kΩ impedance. These attenuators reduce the 5V signal outputs from IC9 to 700mV, as required to produce a full white signal from the following RGB-to-video encoder stage based on IC10.

As shown in Fig.9, the signals from the attenuators are applied to the RGB inputs (pins 6, 7 & 8) of IC10. In addition, the composite sync signal from D7 of IC1 is applied to IC10's pin 16 input. The 4.43MHz crystal on pin 3 provides the colour burst frequency, while the internal phase lock loop multiplies the crystal frequency by four to produce the timing signals for the PAL encoder. Trimmer capacitor VC1 allows the colour burst frequency to be set to 4.43619MHz.

IC10 produces composite video, luminance and chrominance signals at pins 10, 11 and 9 respectively. Switch S4 selects the composite video signal for colour patterns and the luminance output for black and white or greyscale. The only difference between the composite video and the luminance signal is that the latter does not include the chrominance (or colour) information.

The luminance and chrominance outputs can be used to provide S-video signals if required. To add this facility, you would have to install a 75Ω resistor and 470µF capacitor in series with the luminance output and a 75Ω resistor and 0.1µF capacitor in series with the chrominance output.

The video signal on S4's wiper is fed to the video output socket via a 470µF capacitor and 75Ω resistor. It is also fed to a video modulator via VR2 and a 470µF capacitor. VR2 sets the signal level into the modulator, while the associated 10kΩ resistor biases the modulator input to its correct black level.

The modulator also has an audio input and this is fed via a 10µF capacitor. The maximum level that can be applied here is 5V p-p. Power for the modulator is derived from the +12.5V supply from REG3 and is fed via a 180Ω resistor to limit the current through an internal zener diode.

The RF output from the modulator is on either channel 0 or 1, as set by link LK6.

Construction

Despite the complicated way in which it works, this unit is really easy to build. Virtually all the parts are mounted on a single PC board coded 02305971 (173 x 142mm) and this is housed in a standard plastic instrument case with an aluminium front panel. Adhesive dress labels were fitted to the front and rear panels of the prototype to provide a professional finish.

Begin the construction by carefully checking the PC board for shorts between tracks and breaks in the copper pattern. Usually, there will be no problems here but it's best to check before installing any of the parts.

In some cases, it may be necessary to enlarge the mounting holes for the 25-pin D-socket and for the regulator tabs (these holes should all be 3mm). You should also check the hole sizes for the modulator earth mounting lugs, as well as the four corner mounting holes for the PC board.

Fig.10 shows the wiring diagram. Begin the board assembly by installing the links and the resistors. Table 1 shows the resistor colour codes but you should also check each value on a digital multimeter, as the colour bands can sometimes be difficult to read. The diodes can then be installed, taking care to ensure that they are correctly oriented.

Note that two different diode types are used on the PC board, so be sure to use the correct type at each location. The 1A 1N4004s have a black body, while the smaller 1N914s are usually orange in colour.

Seventeen PC stakes are specified in the parts list and these are installed on the PC board at the external wiring points. The exceptions here are points 1-4 adjacent to IC1, where a 4-way pin header is installed to terminate four of the leads from switch S2.

Table 2: Capacitor Codes

Value	IEC Code	EIA Code
0.1µF	100n	104
0.01µF	10n	103
680pF	680p	681
33pF	33p	33

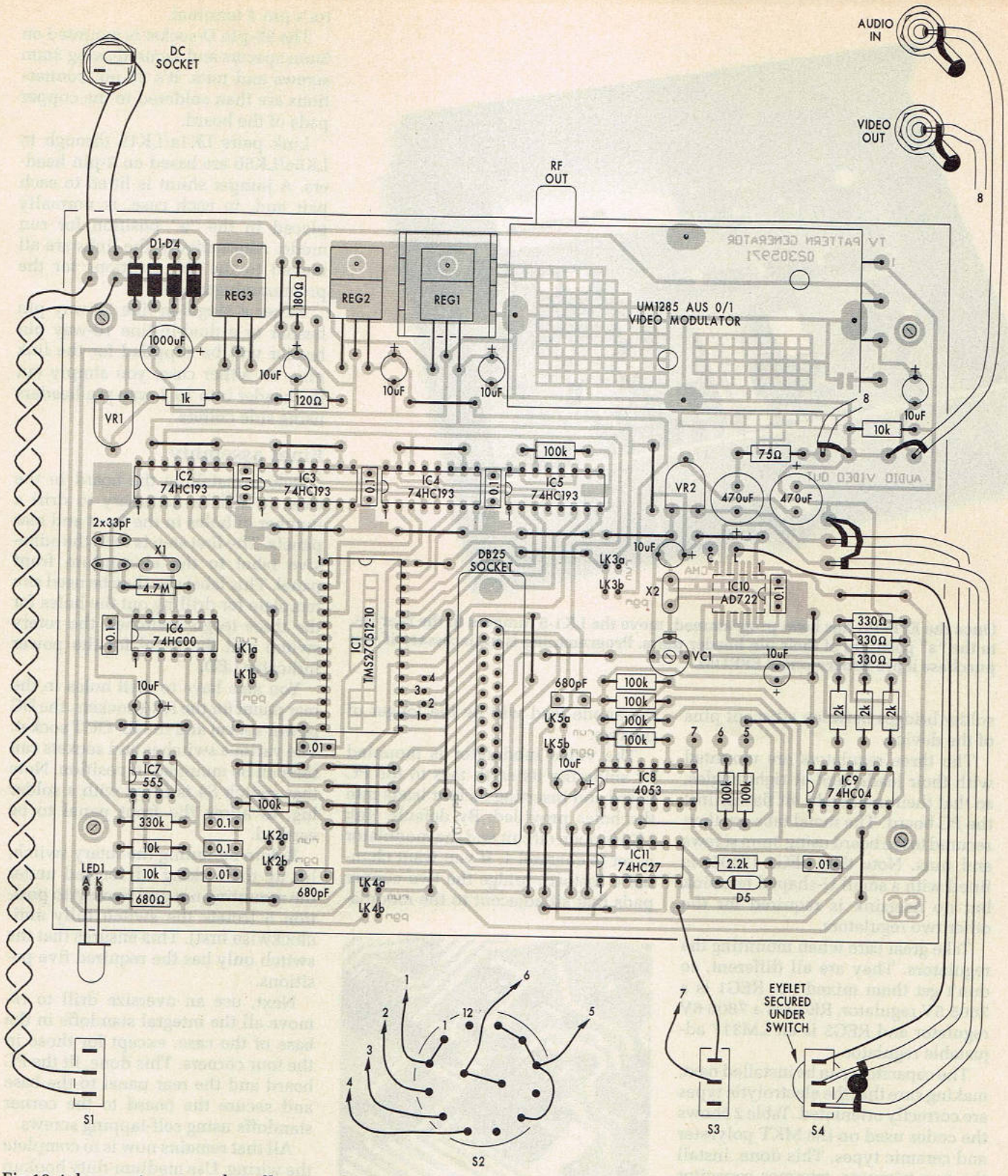
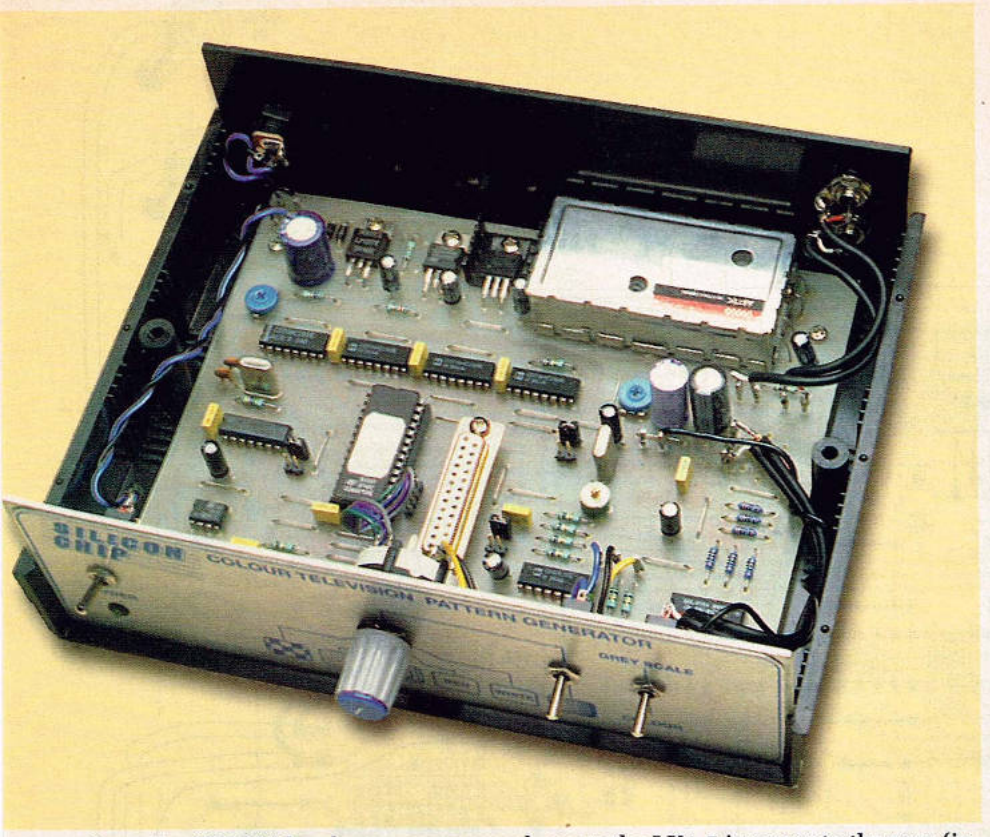


Fig.10: take care to ensure that all parts are correctly orientated when assembling the PC board.

Next, install the ICs in the locations indicated, taking care to ensure that the notched end of each device agrees with the wiring diagram. Use a socket for IC1 and leave this IC out until the testing stage described later on.

IC10 is a surface mount device and is installed on the underside of the PC board as shown in one of the photos. To do this, first pre-tin the copper pad areas where the IC pins will be located, then solder the IC in place using a fine-tipped soldering iron. When you have finished, inspect your work carefully to ensure that there are no



Once the EPROM has been programmed, move the LK1-5 jumpers to the rear (ie, to the "a" position) of their pin header pairs. Programming is unnecessary if you purchase a pre-programmed EPROM.

solder bridges between adjacent pins of the device.

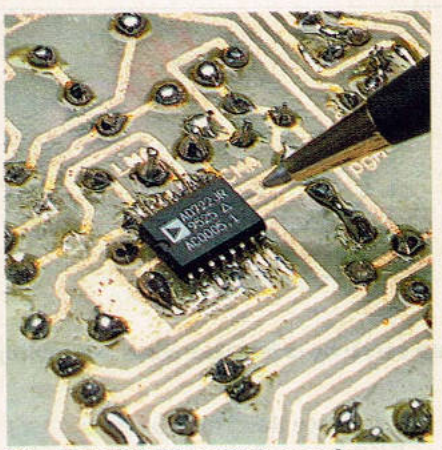
The three regulators are mounted with their leads bent at right angles, so that their metal tabs sit flat against the PC board. The metal tabs are then secured to the board using 3mm screws and nuts. Note that REG1 (7805) is fitted with a small U-shaped heatsink but no heatsink is required for the other two regulators.

Take great care when mounting the regulators. They are all different, so don't get them mixed up. REG1 is a 7805 5V regulator, REG2 is a 7806 6V regulator and REG3 is an LM317 adjustable regulator.

The capacitors can be installed next, making sure that the electrolytic types are correctly orientated. Table 2 shows the codes used on the MKT polyester and ceramic types. This done, install the two trimpots, trimmer capacitor VC1, crystals X1 (3.2768MHz) and X2 (4.43MHz), and LED1. The latter should be mounted at full lead length, so that it can later be bent over and pushed into its mounting bezel on the front panel.

It's easy to identify the LED leads – the anode lead will be the longer of the two.

The video modulator is mounted by soldering its earth tags to the PC board and inserting its four leads into the holes provided. By default, link LK6 is open circuit and the modulator is set to channel 1. If you want channel 0 instead, bridge the two copper pads that sit adjacent to the modulator's pin 4 terminal.



The AD722 RGB-to-PAL encoder (IC10) is a surface mount device and is installed on the underside of the PC board as shown here.

The 25-pin D-socket is mounted on 5mm spacers and secured using 3mm screws and nuts. It's 25-pin connections are then soldered to the copper pads of the board.

Link pairs LK1a/LK1b through to LK5a/LK5b are based on 2-pin headers. A jumper shunt is fitted to each pair and, in each case, is normally placed in the "a" position for run mode. Alternatively, the links are all moved to the "b" positions for the programming mode.

Either a single-in-line 20-way pin header or a dual-in-line 10-way pin header will be supplied for the link pins. In either case, you simply cut the header into 10 2-way pin headers using side cutters.

Final assembly

Before installing the board in the case, it will be necessary to drill a number of holes in the front and rear panels. The first step is to fit the adhesive label to the aluminium front panel. This label can then be used as a template for drilling out the holes for the three toggle switches, the rotary switch and the bezel for the power indicator LED.

You also have to drill holes in the rear panel for the RCA sockets, the DC power socket and the RF OUT socket. The various switches and sockets can then all be mounted in position. Note that switch S4 is fitted with a solder lug, to allow the front panel to be earthed.

Before mounting the rotary switch, lift up the locking tab located under the mounting nut and move it to position 5 (rotate the switch fully anticlockwise first). This ensures that the switch only has the required five positions.

Next, use an oversize drill to remove all the integral standoffs in the base of the case, except for those in the four corners. This done, fit the PC board and the rear panel to the base and secure the board to the corner standoffs using self-tapping screws.

All that remains now is to complete the wiring. Use medium-duty hookup wire for the DC socket, switches S1 and S3, and for terminals 5 & 6 on S2. The connections to terminals 1-4 of S2 are run using rainbow cable, while the connection to the bottom terminal of S4 is run using hookup wire. The remaining connections to S4 and to

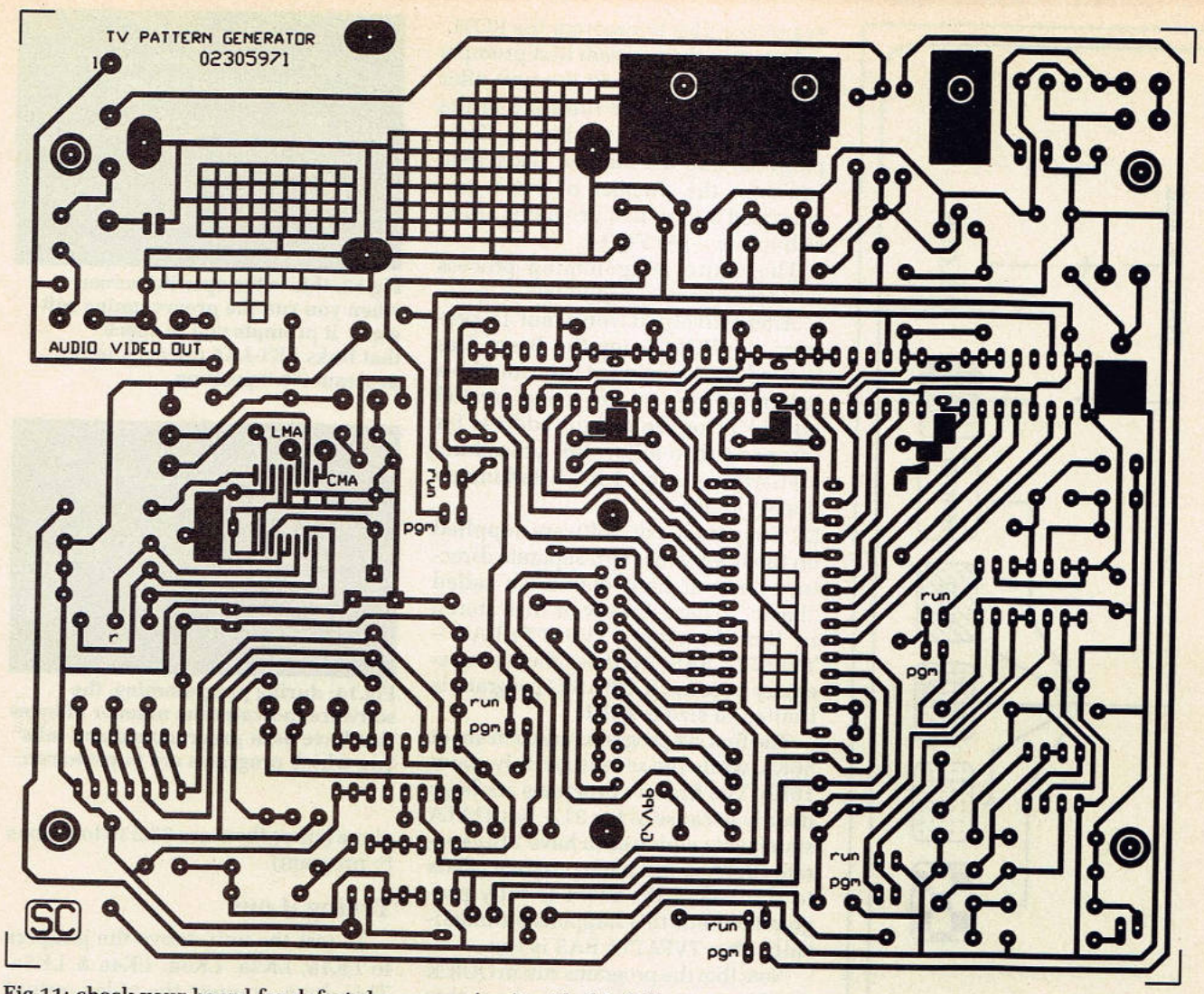


Fig.11: check your board for defects by comparing it with this full-size etching pattern, before installing any of the parts.

the RCA sockets must be run using screened cable.

Finally, complete the construction by pushing the power indicator LED into its bezel and attaching the knob to the rotary switch.

Testing

Before applying power, check to ensure that IC1 has not yet been installed and that the jumpers are in the LK1a, LK2a, LK3a, LK4a and LK5a positions (ie, run mode). This done, you can proceed with the following tests:

(1) Connect the plugpack, apply power and check for 5V between pins 7 & 14 of IC6, IC9 & IC11. Similarly, there should be 5V between pins 8 & 16 of IC2-IC5 & IC8 and between pins 14 & 28 of the socket for IC1.

(2) Monitor the output of REG3 and adjust VR1 for a reading of 12.5V. This done, check for 6V at the output of REG2 and for 0V at pins 20 & 22 of IC1.

(3) If you have a preprogrammed ROM for IC1, switch off the power and plug it into its socket. You can now jump to the section headed "Trying it out".

(4) If your ROM is not preprogrammed, switch off and move the jumpers to LK1b, LK2b, LK3b, LK4b & LK5b. Now reapply power and check that pin 28 of IC1 is at 6V. Pin 20 should be at 5V and pin 22 should be at 12.5V.

If you have access to an oscilloscope, you can check the pulse into pin 20 of IC1 when the -D1 Port C input is pulled low. You can do this by momentarily connecting a jumper lead between the -D1 line and ground. The resulting pulse at pin 20 of IC1 should be low for about 33ms. If all is correct, insert IC1 into its socket and proceed with the programming (not necessary if you have a pre-programmed ROM).

Programming

The ROM is programmed using either Quick Basic files or executable files. The procedure for programming the ROM using the executable files is as follows:

(1) Check that the jumpers are in the LK1b, LK2b, LK3b, LK4b & LK5b positions.

(2) Connect a 25-pin D-plug to 25-pin D-plug lead between the on-board socket and LPT1 of a PC.

(3) Apply power to the pattern generator.

(4) Insert the program floppy disc into drive A: (or B:), go to the A: prompt, type *TVINSTAL* and press Enter. This will automatically decompress and install the files contained within TVPATT.EXE into a directory called

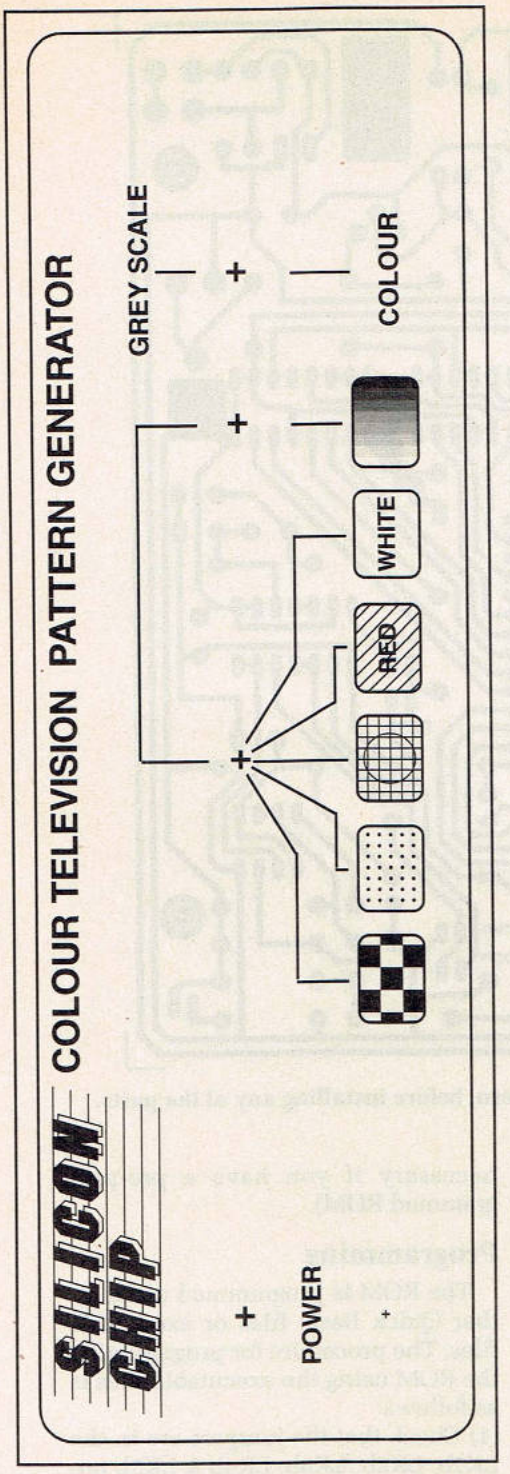


Fig.12: these are the full-size artworks for the front and rear panel labels.

Basic on the C drive.

To start the programming, simply type *TVPGRM* at the C:\Basic prompt. This automatically runs all the relevant .exe files to program the ROM.

Note that the program first prompts you to apply power to the unit after ensuring that all the links are in the program position – see Fig.13. Once programming has started, the screen indicates the number of bytes programmed and which programs are to still to run – see Fig.14.

The entire programming process will take about 45 minutes.

Alternatively, if you want to program the ROM using the Basic files instead (eg, if you want to customise a pattern or you are not using parallel port LPT1 or the default address for this port), then follow this procedure:

(1) Carry out steps 1 & 2 listed immediately above.

(2) Copy the Basic software supplied on the floppy disc to a separate directory on your hard disc drive called "Basic". There are seven files stored in this directory: TVPATT1.BAS – TVPATT7.BAS. All these files are necessary because a QBASIC program is limited in size to 64Kb.

The first six programs are each about 56Kb, while the seventh is only about 16Kb. The first six programs are large mainly because of the 312- line DATA statements which each have 210 separate DATA items. Each program needs to run before the ROM is fully programmed but this happens automatically after TVPATT1.BAS is run.

Note that the programs run in QUICK BASIC, so you will need to have this installed on your computer. The address of the port used is 378(HEX) to 37A(HEX). If you want to use a different port, then the address in each program will have to be altered to suit. The address used is the standard LPT1 port found in virtually all PCs.

(3) Start by opening TVPATT1.BAS in QUICK BASIC and then running it by clicking on the RUN command. The screen shown in Fig.13 appears.

(4) Wait a few seconds after switch on to give time for the power-on reset to take place, then press Enter on the keyboard to start the programming. When TVPATT1.BAS has finished, the next program (TVPATT2.BAS) will automatically run and so on in sequence until programming is complete.

As before, the entire process takes about 45 minutes. Note that each location in memory takes at least 33ms to program because of the programming pulse length and that represents a total of 36 minutes programming time alone (since there are 65,536 locations to program).

SILICON CHIP
TV PATTERN GENERATOR ROM PROGRAM
MAKE SURE THAT THE TV PATTERN GENERATOR
IS SET WITH THE FOUR CONNECTIONS FOR PROGRAMMING
AND APPLY POWER TO THE CIRCUIT
PRESS RETURN KEY TO BEGIN PROGRAM

Fig.13: this is the opening screen when you run the programming software. It prompts you to check that links LK1-LK5 are each in the program ("b") position.

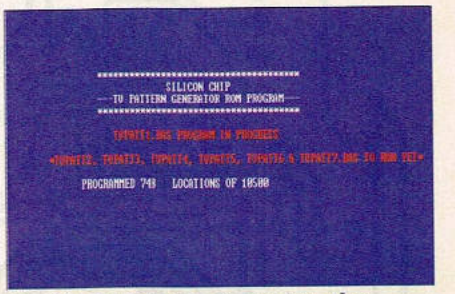


Fig.14: during programming, the software indicates the number of bytes that have been programmed and tells you which programs are to yet to run.

Trying it out

To test the unit, move the jumpers to LK1a, LK2a, LK3a, LK4a & LK5a. This done, connect the video output from the unit to the video input of a VCR and tune a TV set to the video channel. Alternatively, if the TV has a direct video input, you can connect the pattern generator to this instead.

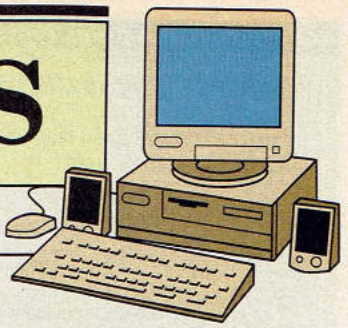
Apply power and check that all the patterns can be selected via the front panel switches. If the TV does not show colour for the colour bar selection, adjust VC1 until colour appears.

Note that, with some EPROMs, the display may rapidly switch between colour and b&w. This can be cured by connecting a 100pF ceramic capacitor between pins 11 & 14 of IC1 (on the underside of the PC board).

Finally, connect the RF output from the pattern generator to the antenna input of the TV set and tune the set to the appropriate channel (0 or 1). Adjust VR2 for best colour bar reception. If the signal level from VR2 is too low, the colours will not be saturated. Conversely, if the signal level is too high, there will be no colour at all. **SC**

COMPUTER BITS

BY JASON COLE



Removing programs from Win95

Windows 95 has changed the way that PC users install and uninstall software. No longer are you left to your own resources. Instead, a wizard takes over and guides you through the process.

A "wizard" is a function that guides the Windows 95 user through various steps and options by means of a series of dialog boxes, often with a quick sentence or two about what it is doing.

Sometimes, the use of a wizard is optional but when installing hardware and software, they appear automatically. A wizard makes the process of installing and removing hardware and software a truly "user friendly" operation. Once upon a time, before Windows 95, you were presented with a list of options when installing a program in DOS or Windows 3.x. Typically, there could be messages concerning the sound card, the program location, the monitor resolution and so on.

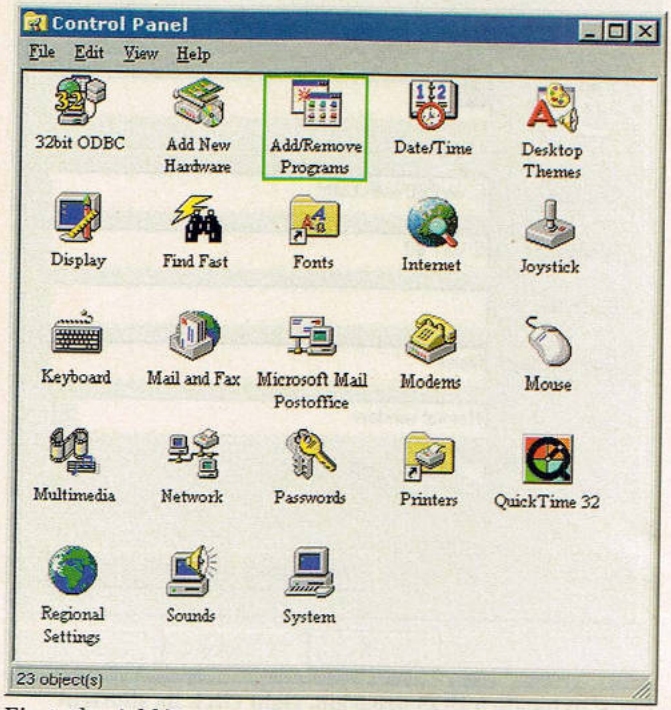


Fig.1: the Add/Remove Programs icon is in the Windows 95 Control Panel (click Start, Settings, Control Panel).

Those people with experience in computers knew that these were questions, not statements; that the computer was asking you what sound card you had, where the program was to be copied to and what screen resolution you wanted to run. By contrast, in Windows 95, the installation's wizard will ask something like: "Please select the location your program should be installed to".

Of course, the wizard will usually show a default location. You can either use this default location or you can easily select another location. The wizard steps you through your selections, prompts you for information, and gathers other details which are already known to Windows 95; eg, your name and organisation.

When it has all the necessary information, the wizard works with Windows 95 to correctly install the software and will report on the success of your task.

Uninstalling programs

Windows 3.x did not come with an uninstall utility, so deleting programs could be tricky unless you used a third party uninstall utility or the program came with an uninstall option. That situation changed with Windows 95. Once again, a wizard is used to uninstall programs.

There are a number of ways to remove programs from Windows 95. The most common method is to use the Add-Remove Programs Icon in the Control Panel. You access the Control Panel by clicking *Start, Settings, Control Panel.*

A window similar to that shown Fig.1 will appear. You then double-click the *Add-Remove Programs* icon to start the wizard – see Fig.2.

To uninstall a program, simply highlight its name and click the *Add/Remove* button. Another dialog box will appear asking for confirmation. If there are multiple versions installed or if companion products were installed, a further dialog box will appear to make your uninstall requests more specific. The wizard will delete all components of the program, with the exception of custom documents or images.

A comprehensive uninstall removes all relevant files and folders belonging to the program, as well as any

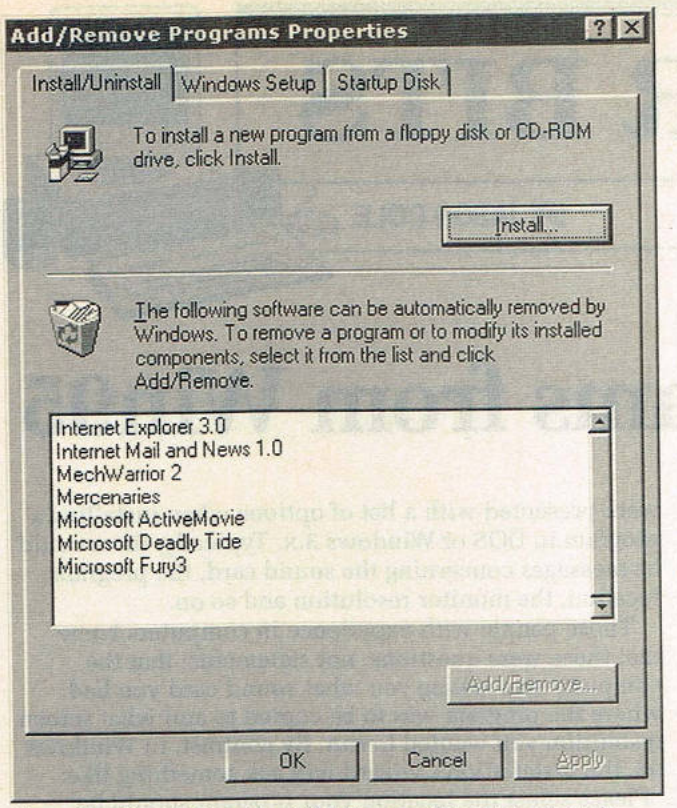

Add/Remove Programs Properties
Install/Uninstall
Windows Setup
Startup Disk
To install a new program from a floppy disk or CD-ROM drive, click Install.
Install...
The following software can be automatically removed by Windows. To remove a program or to modify its installed components, select it from the list and click Add/Remove.
Internet Explorer 3.0
Internet Mail and News 1.0
MechWarrior 2
Mercenaries
Microsoft ActiveMovie
Microsoft Deadly Tide
Microsoft Fury3
Add/Remove...
OK
Cancel
Apply

Fig.2: double-clicking the Add/Remove Programs icon in the Win95 Control Panel starts the Install/Uninstall wizard.

information that may have been added to the Win.ini and System.ini files when the program was originally installed. When the uninstall process is complete, the wizard returns you to the original Add-Remove Programs dialog box.

Occasionally, the uninstall option for a program may also appear in the Start menu or it may only be found there. For example, you uninstall Adobe PageMaker 6.5, by clicking *Start, Programs, Adobe, PageMaker 6.5, Uninstall PageMaker 6.5.*

Problems with uninstall

As is the way with computers, an uninstall procedure doesn't always go smoothly and the wizard may encounter a few problems. A few typical examples are as follows:

(1). The uninstall wizard may not be able to find all the program files. This is because some files have already been removed or relocated.

(2). When removing some programs, you may be asked if you want to remove a file that's shared by another program. Unless you know for certain that the file is not used by another program, do not remove it. Removing shared files can stop other programs from working correctly.

For example, a spelling dictionary may be shared by Microsoft Word and Microsoft Access. Remove it for one and it is no longer available for the other. Of course, this is just one example; other file types, including DLLs (dynamic link libraries), may also be also shared.

(3). Sometimes, the original installation CD or disc must be in the drive in order for the wizard to work.

The wizard will report any problems that it encounters during the unistall process and you can refer to Windows Help (F1) if you don't understand the message. This should help you overcome any problems. For example, files that cannot be located by the wizard can be removed manually.

If the uninstall wizard asks for the installation disks, then provide them. If you cannot do this, make a note of the message and select "Ignore" to continue. In some cases, you may need to reinstall a program to enable correct uninstallation. If the wizard does not give you the ignore option or stops working, end the task by pressing Ctrl + Alt + Delete at the same time and then choosing close. In this case, manual deletion may be the only option left.

If another program stops working after an uninstall, a quick reinstallation of the affected program will fix the problem.

A common problem with uninstall occurs when multiple versions of Microsoft Office have been installed. This may happen, for example, where Office 97 has been installed but the previous version has been kept to give the user time to adjust to the latest offering. If the user subsequently decides to delete the old version, he quickly discovers that the wizard can only delete the new Office 97 version. The previous version isn't an option any more.

Microsoft overcame this problem by including a program called OFFCLN97.EXE (Office Clean 97) on the new CD. This program goes through the hard disc drive and removes any remnants of Office 95 or Office Ver. 4.X, so keep this in mind if you are ever in this situation.

Occasionally a program may require an uninstallation

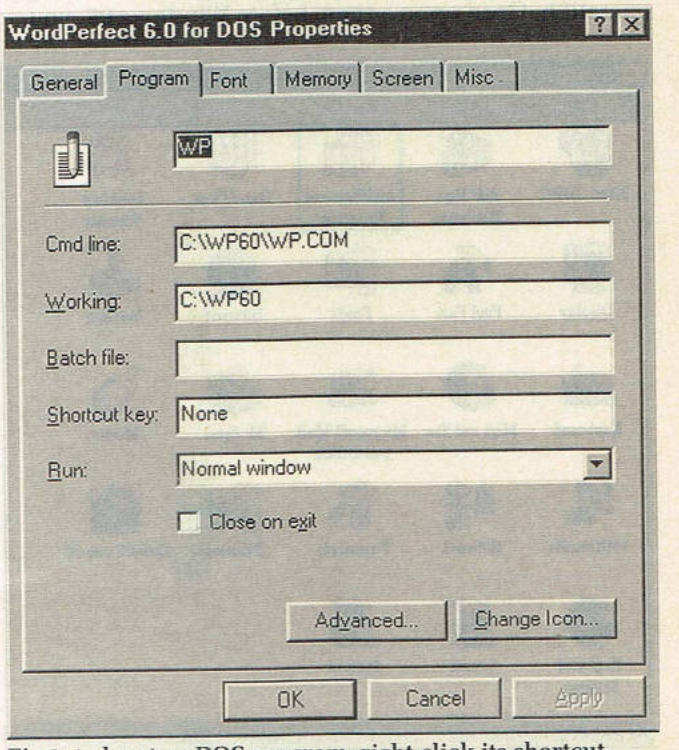


Fig.3: to locate a DOS program, right click its shortcut icon, then click Properties and select the Programs tab. The program's location is indicated by the Cmd line entry.

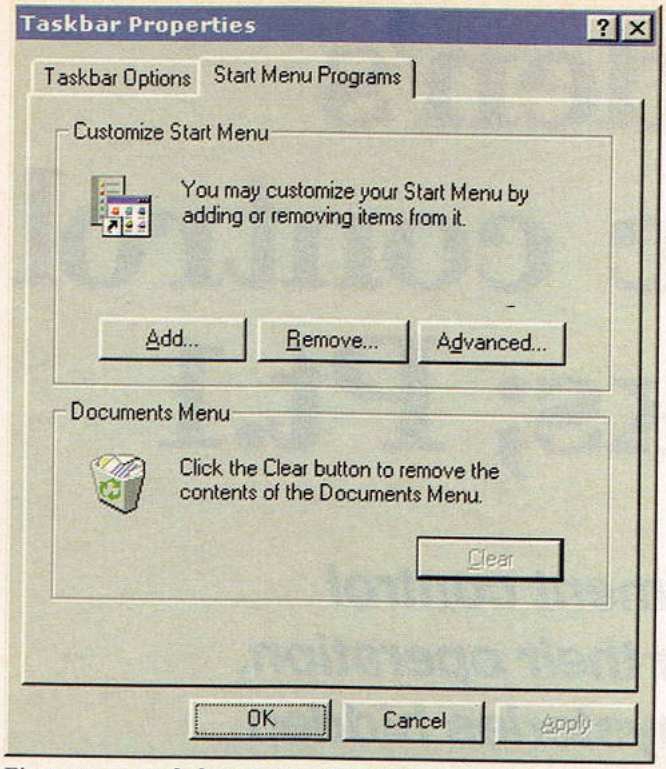


Fig.4: unwanted shortcuts and/or folders are deleted from the Start menu using the Taskbar Properties options.

procedure that the standard uninstall wizard does not handle. In that case, the Setup utility that came with the program will usually do the job. A typical example is Microsoft Plus! (the add-on enhancement pack for Windows 95). Its setup program gives you three options: (1) Add/Remove; (2) Reinstall; and (3) Remove All. These first option is quite powerful because it lets you selectively delete (or add) certain elements of Plus!

Windows 3.x

As mentioned above, Windows 3.x did not come with an uninstall wizard. And although some Windows 3.x programs came with an uninstall option, most did not. Apparently, the programmers thought that once you started using a program, you wouldn't want to delete it!

Those programs that did provide an uninstall option worked in a similar way to those that ran under Window 95. However, they were often harder to understand and occasionally failed, either not working at all or only deleting part of a program. Sometimes, the uninstall utility of one program removed files that were also used by other programs.

Always check the manual for a program when removing it from Windows 3.x. Often, it will give step-by-step instructions for removing the program and will list the entries that were added to System.ini and Win.ini.

DOS programs & Windows 3.x

DOS programs that run inside Windows 3.x are usually easy to unistall. Typically, this involves deleting: (1) program files and folders; and (2) Windows icons and groups.

The question is, how do we know where the program is located? Simple – just highlight the program's icon, then click File, Properties (or press ALT-Enter). The program's location is indicated by the Command Line entry. The working directory will often be in the same location but this is not always the case.

Once the relevant directory has been located, it can be erased using File Manager. To remove the program's icon, simply select it and press the Delete key. A program group is removed in the same way.

DOS programs & Windows 95

The manual removal of DOS programs in Windows 95 is similar to the above procedure. The location of the program can be found by right clicking its shortcut icon and then clicking *Properties* and selecting the *Program* tab to bring up the dialog box shown in Fig.3.

You also have to remove the shortcut, either from the desktop or from the Start menu (or both). If the shortcut is on the desktop, simply highlight the icon and hit the Delete key. If the shortcut is in the Start menu, you delete it using the Taskbar Properties option.

To do that, click *Start, Settings, Taskbar*, then select the *Start Menu Programs* tab to get the dialog box shown in Fig.4. You then click the *Remove* button to get a list of directories and files similar to those shown by Explorer (only smaller in size).

Now find the shortcut you don't want, highlight it and press Remove. The shortcut will be sent to the Recycle Bin. You can delete unwanted folders from the Start menu in exactly the same fashion.

Windows 3.x programs & Windows 95

What about Windows 3.x programs that have been installed under Windows 95? Those that don't have an uninstall option are removed in the same manner as for Windows 3.x, except that files and folders are deleted using Explorer rather than File Manager.

Another approach is to purchase an uninstaller program. An uninstaller program tracks the installation and keeps a record of it, so that it can uninstall the application later on. A popular choice is Uninstaller 4 which is designed for Window 95 and Windows NT but there's also a version for Windows 3.x.

Registry & ini files

Windows 3.x used "ini" files to store program settings, the two most important being System.ini and Win.ini which are stored in the Windows directory. Any programs installed in Window 3.x added entries to these and to other ini files. That's because, during the Windows boot sequence, these files tell Windows what's installed and where to find it.

With Windows 95, however, most of the information is stored in the registry. It still stores some information in Win.ini and System.ini but this is for compatibility with older programs. By the way, Windows 3.x also stored some information in a registry but it was not used extensively.

Do not go into the registry unless you have a backup and know exactly what you are doing. The registry is an important part of Windows 95 and should not be treated lightly. Remove the wrong bit of information and you may have to reinstall Windows 95. **SC**

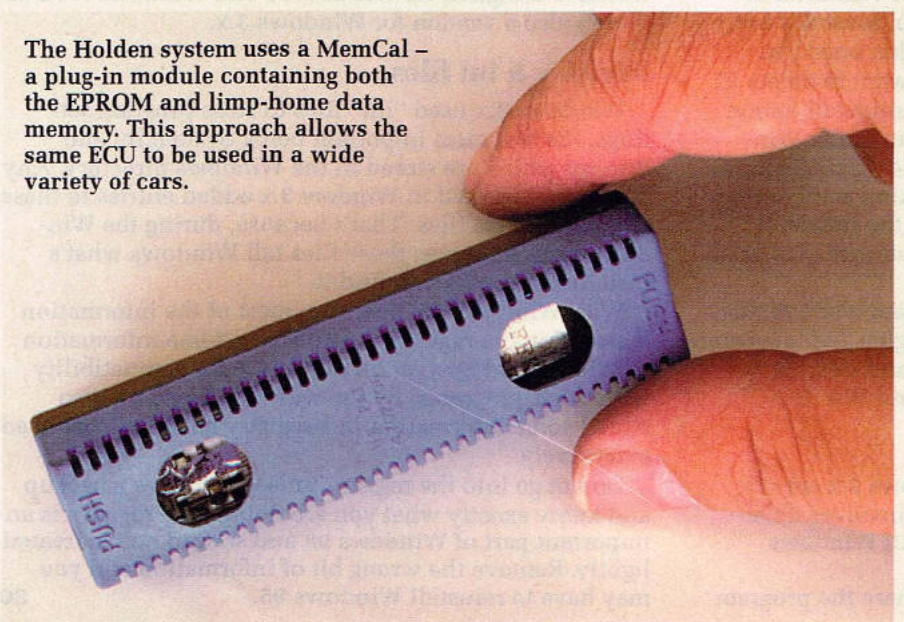
How Holden's electronic control unit works; Pt.1

The latest engine management control systems are very clever in their operation. We unravel some of the mysteries hidden in the Holden system.

By JULIAN EDGAR

ALTHOUGH THERE have been many articles published on electronic engine management systems, a detailed analysis of how the program in an Electronic Control Unit (ECU) works has been lacking. This is because the manufacturers do not publish such studies and usually no other sources have sufficient depth. However, the way in which one ECU calculates its outputs can now be revealed.

Ken Young, an Australian computer programmer, has developed a sophisticated software package that allows the AC-Delco engine management system to be reprogrammed. This is the engine management system used on the Holden Commodore.



The Holden system uses a MemCal – a plug-in module containing both the EPROM and limp-home data memory. This approach allows the same ECU to be used in a wide variety of cars.

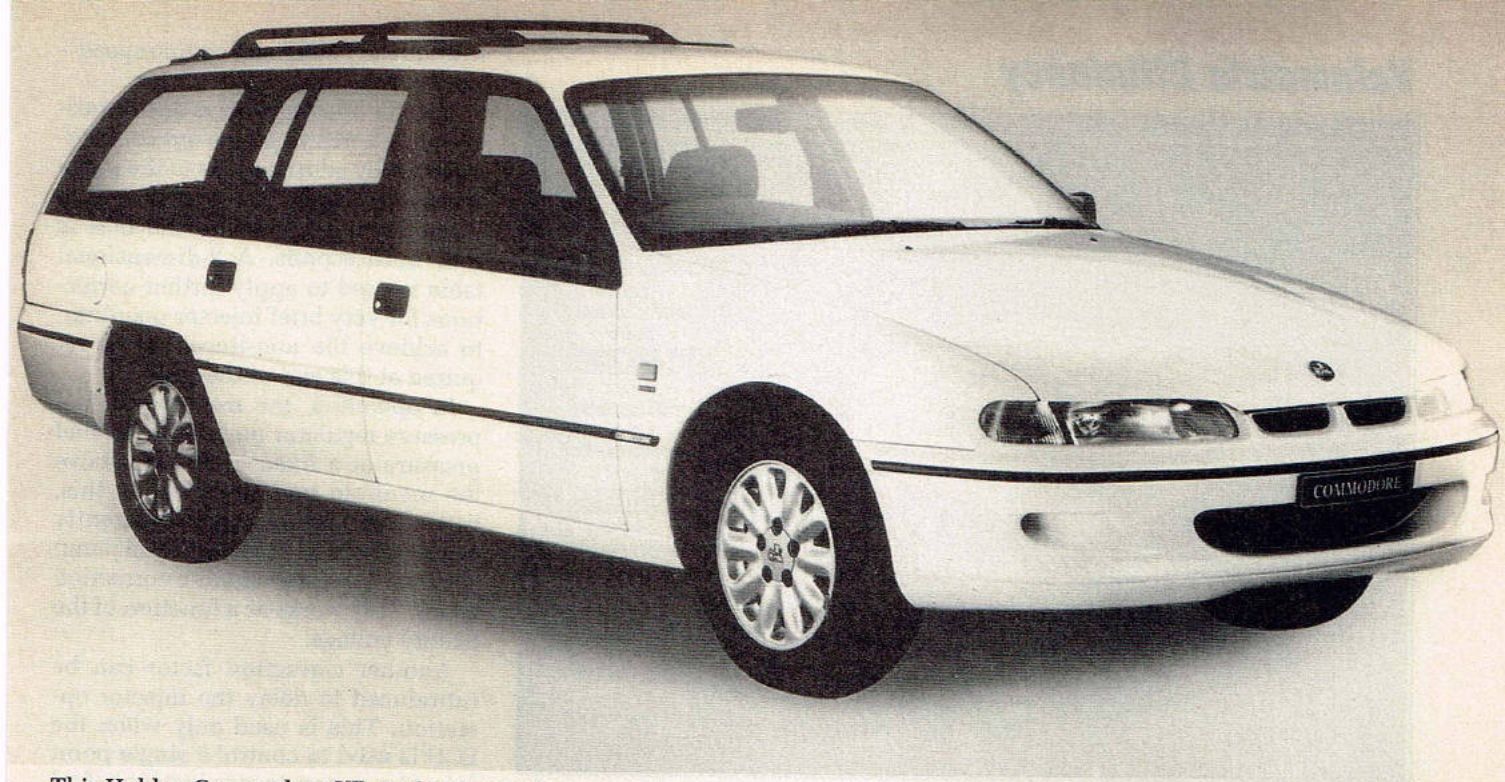
In order to develop an effective, user-friendly software package (plain English is used on the screen), he needed to completely lay bare the programming of the ECU. This he has done and much of what follows is drawn with his permission from the manuals for his KAL Software DynoCal package.

The story reveals the almost unbelievable sophistication of the modern engine management ECU. Indeed, the GM-Delco ECU is far more complex in its operation than most aftermarket programmable systems.

Note that while all the variables can be altered using the DynoCal software, the values used as examples here are from a standard Holden VR V6 automatic program. Note also that what follows relates mainly to engines which use a MAP (manifold absolute pressure) sensor, as opposed to engines using an airflow meter (as in the EcoTec engine fitted to the VS Commodore).

Basic ECU layout

As with all engine management systems, the GM-Delco ECU accepts in-



This Holden Commodore VR station wagon has an engine management system that was once undreamt of.

puts from a variety of sensors, makes appropriate decisions, and then outputs various signals. The various sensors provide either analog voltage inputs (throttle position sensor, oxygen sensor); pulse inputs (distributor reference, speed); or simple on/off logic inputs (airconditioner compressor clutch, gear lever neutral/drive position).

The various outputs consist of pulse width modulated pulses (for the trip computer), simple on/off outputs (engine check light & radiator fan), timed spark pulses and injector pulses (to control the fuel injectors).

In the GM-Delco system, both the program and the data are stored on a single EPROM. In GM-talk, this EPROM is called the "MemCal" and by using different MemCals, GM has been able to use the same basic ECU on a variety of engines, including fours, sixes and eights. The program tells the controller what to do and consists of machine code, while the data is made up of an incredible 300+ variables which tailor the program to the specific drivetrain application.

Over the years, Holden has used three different ROM sizes in the GM-Delco systems. The first systems used a 16Kb EPROM but this was later doubled in size to 32Kb. Of this, about 30Kb was used for the program and the remaining 2Kb for the calibration data. Holden subsequently added automatic transmission control to the ECU. This new ECU is now called a PCM (Powertrain Control Module) and its EPROM has again doubled in size to 64Kb.

Variables

There are four different types of variables used by the program:

(1). So-called zero dimension variables – these are used to specify the number of engine cylinders, whether there is an automatic or manual gearbox installed, etc.

(2). One dimensional variables – these are used to represent counters, delays, air/fuel ratios, etc.

(3). Two dimensional variables – these are look-up tables comprising such factors as idle air motor steps versus rpm, air/fuel ratios versus time, etc.

(4). Three dimensional variables – these are the 3D maps; eg, air/fuel ratio versus rpm versus MAP (manifold absolute pressure).

The program logic can be divided into six main areas of operation: fuel, spark, idle air control, diagnostics, output logic and variables. In addition, the program determines a number of internal modes, such as whether the engine is cranking or running and whether or not the oxygen sensor is operational. These modes are saved and used in various calculations.

Only two of the program areas are examined here: fuel and spark. Let's see how the program actually calculates the various outputs?

Calculating fuel injection

The step-by-step process followed to calculate the required amount of fuel is:

(1). Estimate of the mass of air entering the engine;

(2). Look-up the desired air/fuel ratio for the engine speed and MAP;

(3). Multiply the air mass by the fuel/air ratio to give the fuel mass required;

(4). Use the fuel mass to calculate the injector pulse width.

The air mass per cylinder is calculated from the manifold pressure, intake air temperature and engine speed. This figure is then multiplied by the volumetric efficiency of the engine. A 3-dimensional table is used to specify low rpm volumetric efficiency, which is calculated as a function of engine speed and MAP. Another similar look-up table is used for high rpm volumetric efficiency.

If the coolant temperature is below 44°C, a correction is applied to the air/fuel ratio to enrich the mixture.

Volumetric Efficiency

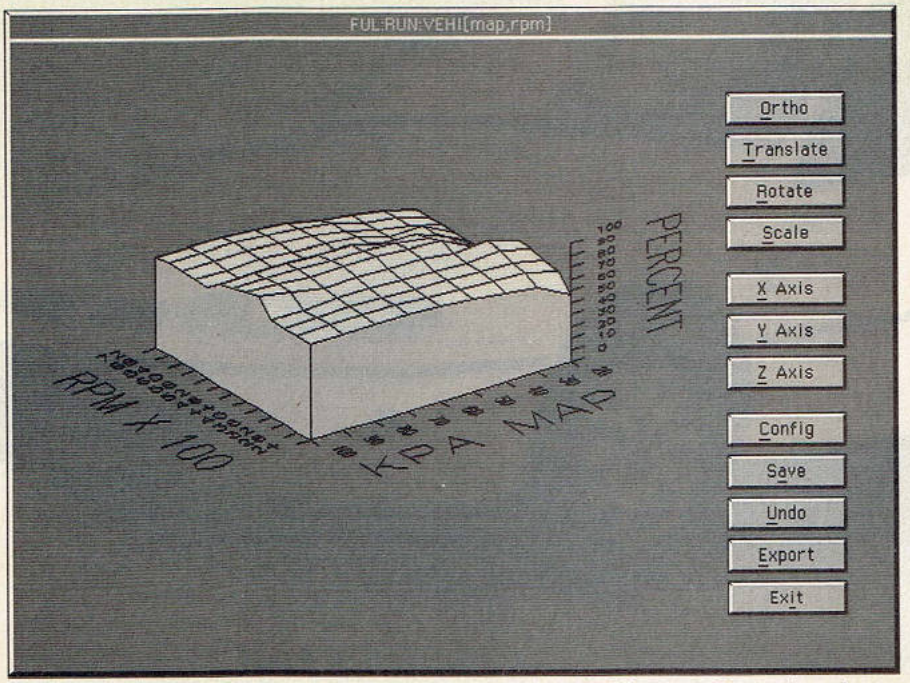


Fig.1: the volumetric efficiency (VE) of the engine is held as a 3-dimensional map. Here, the VE is shown as a function of engine speed and manifold pressure. Note that for some combinations of manifold vacuum and engine speed, the charging efficiency is markedly improved – probably as a result of the tuned-length intake system.

Air/Fuel Ratio

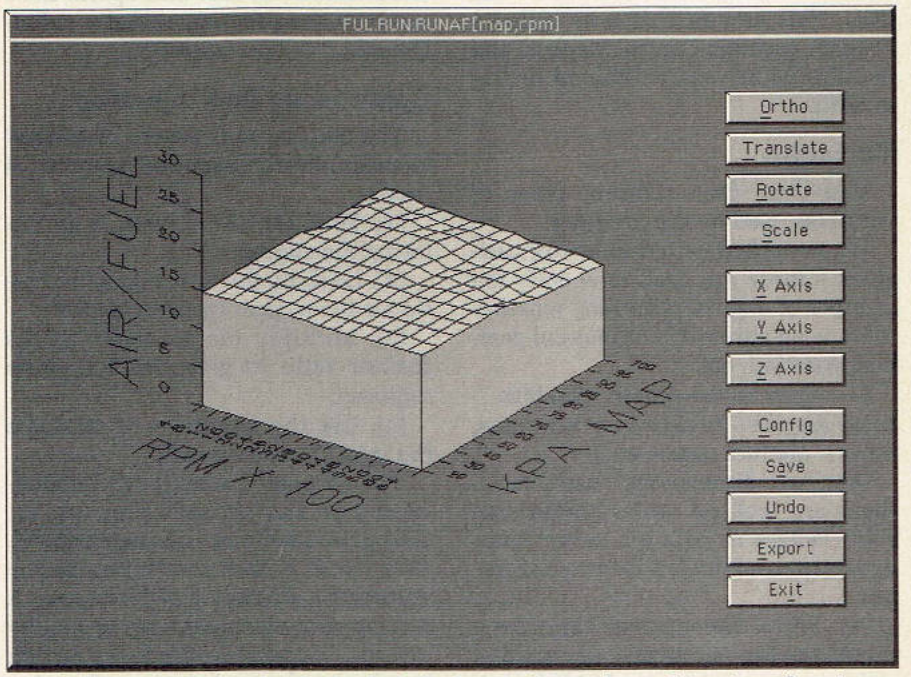


Fig.2: this map shows the desired air/fuel ratio for each combination of engine speed and manifold vacuum. For general running, the engine management system is programmed so that it maintains these ratios as closely as possible.

Two further single-dimension variables control the decay rate of this enrichment and the minimum to which it can fall. The main air/fuel ratio look-up table uses three dimensions, with air/fuel ratio expressed as a function of MAP and engine speed – see Fig.2.

Injector opening delays due to variations in battery voltage are compensated for by adding a bias to the injector pulse width. For example, at a battery voltage of 11.2V the bias is 1.16 milliseconds. A 2-dimensional table is used to apply further corrections for very brief injector openings, to achieve the non-linear biases required at this end of the scale.

In operation, the mechanical fuel pressure regulator maintains the fuel pressure at a fixed headroom above the manifold pressure. Despite this, battery voltage changes apparently cause sufficient variation in fuel pump pressure to require another correction factor. This works as a function of the battery voltage.

Another correction factor can be introduced to delay the injector operation. This is used only when the ECU is used to control a single point injection system to give better air/fuel mixing. It is not used in the Commodore, since the V6 employs multi-point fuel injection.

Lean cruise mode

One of the factors giving the Commodore such good open-road fuel consumption is the lean cruise mode. Lean cruise is enacted when the coolant temperature is above 80°C and the road speed higher than 68km/h. After 150 seconds, the air/fuel ratio is increased in 0.1 steps at 0.2 second intervals. This increase is ultimately limited to a value derived from a 3-dimensional look-up table and depends on the engine speed and MAP.

As you might expect, the way in which the fuel injectors are controlled during engine starting is rather complicated. There are preset variables for cranking pulse width and also for the decay rate of this base crank pulse width. The steps at which the pulse width decays are also specified. The clear flooding throttle position is set at 98% opening or more and the injector pulse width is reduced to 7.895 milliseconds during cranking with the throttle in this position.

No less than 22 different variables are used to control the mixture during acceleration and deceleration! These variables include coolant temperature which is used to control the rate at which the mixture is leaned off during deceleration.

A large number of variables are also used for closed loop running, whereby the oxygen sensor controls the mixture. The minimum coolant temperature at which closed loop running will start is 44°C at idle and 31.25°C for running conditions. The program takes six seconds before it switches from open loop to closed loop after acceleration and it will do this only with a manifold vacuum of more than 5kPa.

Fuel trim

The Short Term Fuel Trim is a fast-acting air/fuel ratio correction system which relies on the output of the oxygen sensor. In operation, the oxygen sensor outputs a voltage signal which is categorised as either rich or lean. The longer the ECU receives a rich (or lean) signal, the greater the correction that is applied.

This results in an air/fuel ratio under closed loop conditions that oscillates around the stoichiometric point (this characteristic cycling of mixtures can be seen on the SILICON CHIP mixture meter – see November 1995).

Further corrections are applied by the Long Term Fuel Trim (LTFT) which uses an array of 24 block memory cells. Each cell corresponds to an rpm and MAP range, with the array covering the engine's operating range.

When the engine is operating in closed loop mode, the fuel term is calculated and then multiplied by the cell which corresponds to the rpm and MAP conditions present. If the engine has operated with that manifold vacuum and engine speed for a number of seconds, a learning process takes place. The data in one block can affect the data in neighbouring blocks, thereby allowing smooth interpolation to take place between them. Disconnecting the battery clears these memory cells, which means that a car may operate below its optimum performance level for a short period of time when it is driven again.

The LTFT RAM data can be accessed after the event, meaning that the ECU has continuous on-board data logging of the air/fuel ratio at 24 different load/rpm sites. For the LTFT to become active, the oxygen sensor must be working correctly and the engine speed must be constant.

Over-revving is prevented by cutting off the fuel at 5800 rpm and restoring it again when the engine speed falls below 5700 rpm (ie, there is 100

Main Spark Advance

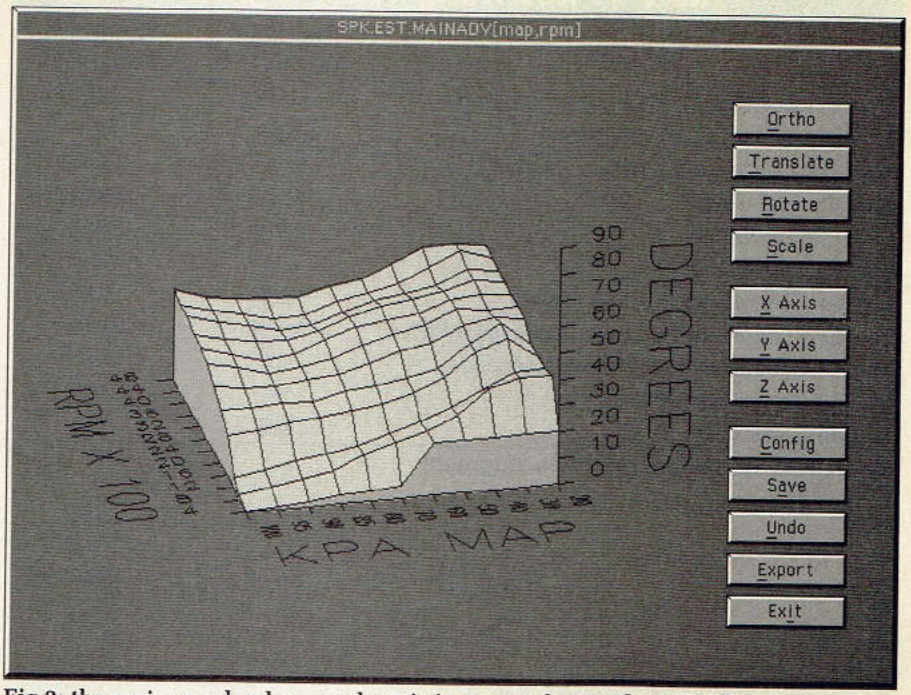


Fig.3: the main spark advance chart is just one of a number of maps used to calculate the spark advance. If the engine is at idle, the timing is taken from a 2-dimensional look-up table as a function of MAP. At other engine speeds, the initial spark value is derived from this 3-dimensional table which shows spark advance as a function of engine speed and MAP.

Long Term Fuel Trim

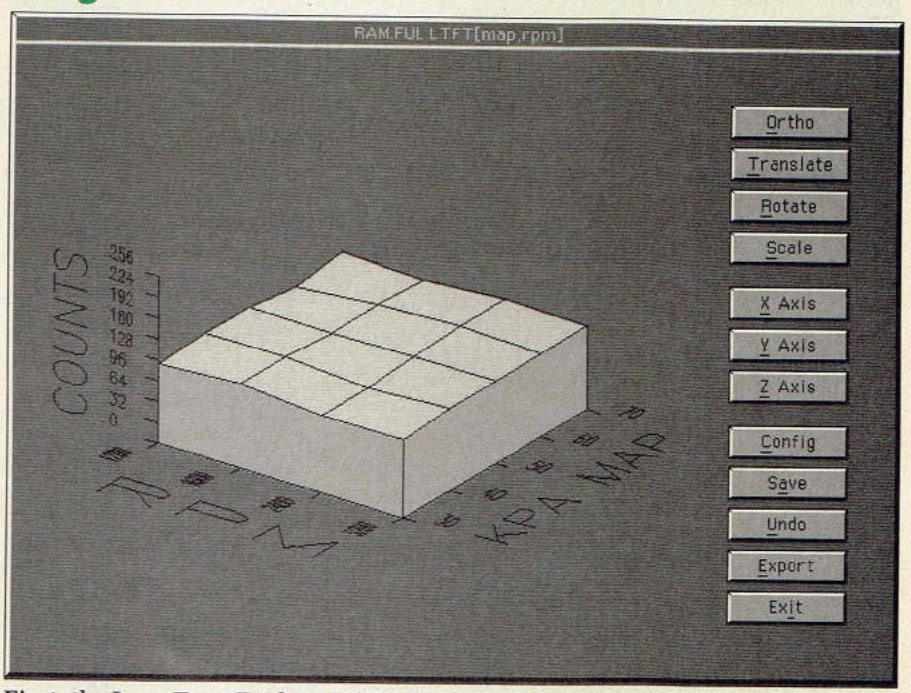


Fig.4: the Long Term Fuel Trim (LTFT) is an inbuilt form of data logging. It stores the corrections made to the injector pulse widths so that the air/fuel ratios depicted in Fig.3 are maintained. A count of 128 indicates that no correction has been required, while a count that's less than 128 means that the engine has been running lean. Conversely, a count greater than 128 indicates that the engine has been running rich. It can be seen that this particular engine has required only minor on-going corrections.

Table 1: Rewriting The Program

Variable	Modified Holden V6	Standard Holden V6
Spark High Advance Rate (degrees/1000 rpm)	1.98	2.03
Spark Maximum Retard (degrees)	9.84	8.09
Fuel Max Pulse Width (milliseconds)	24.002	10.986
Fuel Cut Low RPM	6300	5715
Fuel Cut High RPM	6400	5817
Fuel Cut Time Delay (seconds)	0.04	0.10
Idle Air Control Max Position (steps)	220	196
Idle Air Control Closed Loop Threshold (kPa)	39.86	34.33
Idle Air Control Warm Up Decay (seconds)	10	5
Idle Air Control Deadband (rpm)	18	50
Idle Air Control Sag (rpm)	206	400
Spark Idle Air Control Advance (degrees) (kPa MAP)		
20	20.39	26.02
30	24.26	26.02
40	30.59	26.02
50	31.99	26.02
60	30.94	26.02
70	26.37	26.02
Spark Attack Rate (degrees/count) (rpm)		
1600	0.038	0.030
3200	0.065	0.030
4800	0.069	0.030
6400	0.080	0.030
Fuel Volumetric Efficiency (%) (kPa at 400 rpm)		
20	13.3	53.5
40	16.4	62.5
60	20.3	53.5
80	26.6	58.2
100	33.6	71.1
(kPa at 1600 rpm)		
20	31.2	44.9
40	37.1	67.2
60	40.2	73.4
80	50.0	78.9
100	62.1	81.2
(kPa at 3200 rpm)		
20	44.9	60.5
40	53.5	82.4
60	64.5	85.5
80	70.3	87.1
100	76.2	84.4
(kPa at 6400 rpm)		
20	66.0	50.8
40	70.3	62.5
60	76.2	74.2
80	89.1	78.1
100	99.6	78.1

rpm of hysteresis to prevent oscillation around the cutoff point). The same technique is also used to limit the road speed, with the VR V6 automatic model limited to 210km/h.

During manufacturing, the program is configured to recognise a stoichiometric air/fuel ratio whose value corresponds to the switching voltage of the oxygen sensor being used. An injector constant is also programmed, allowing larger or smaller injectors to be used in place of the standard units.

Spark timing

The initial timing information for the ECU is derived from a crankshaft position sensor at 60° or 70° before top dead centre (TDC). The ECU then calculates the required spark timing, counts forward and delivers the spark.

If the engine is at idle, the timing is taken from a 2-dimensional look-up table as a function of MAP. At other engine speeds, the initial spark value is derived from a 3-dimensional table which shows spark advance as a function of engine speed and MAP. At low MAP pressures (ie, high vacuum), the table has increased resolution. In addition, for engine speeds above 4800 rpm, a high-rpm correction figure is added to the main advance rate.

The output of the 3-dimensional coolant correction chart is then used to modify the timing. This chart shows the correction as a function of coolant temperature and MAP. Negative coolant corrections are made by subtracting another variable (coolant offset) from the positive value coolant correction chart.

If exhaust gas recirculation were to occur, the spark would be further advanced as a function of MAP and engine speed. However, this function is not currently employed. Another correction not currently used (but available) is for barometric pressure.

Timing refinements

While the timing procedure so far is fairly straightforward, there are a number of refinements. For example, when the automatic transmission is shifted from Park or Neutral into Drive, the timing is retarded by 5.98° if the engine speed is above 3600 rpm. This is done to cushion shift-shock (the lurch that occurs when shifting into gear).

The spark advance is also increased by an amount proportional to the rate of acceleration. However, the maximum rate of change in spark timing is limited to 0.01°/milliseconds on the VR V6 engine.

Depending on the coolant temperature, the rate of change for the throttle position can also be used to retard the spark timing. However, the spark retard logic is bypassed if the vehicle

speed is less than a preset variable or if the engine speed is higher or lower than other preset values. When deceleration fuel cutoff is employed, the spark timing is decayed until a minimum value is reached before the actual fuel cutoff starts.

During starting, an initial timing value is selected and this is then modified according to the cranking speed by a 2-dimensional chart. However, if the cranking speed falls below 400 rpm, the crankshaft position sensor output becomes inaccurate. When this happens, the spark is generated by the ignition module using a backup mode. The ECU switches the spark timing back to its normal mode when the engine speed rises above 400 rpm.

Once the engine is idling, a 2-dimensional table stores the timing values as a function of MAP. Interpolation is used if the MAP value falls between two points.

At the end of the timing calculations, the calculated advance angle is checked against a 1-dimensional variable which set the maximum and minimum values. These are at 60.2° and -17.8°, respectively.

Another spark timing variable set during manufacture establishes the engine position at which the distributor reference pulse occurs. There is also a crankshaft position sensor lag correction factor. This correction compensates for the electronic delays in the sensor and pick-up and is set to 200 microseconds for the V6.

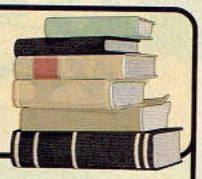
In fact, more than 70 variables (ranging from 1-dimensional to 3-dimensional) are used in the calculation of the final spark advance! As a comparison, some aftermarket programmable engine management systems rely on just five or six variables.

Rewriting the program

One way to examine the capabilities of the ECU is to examine a rewritten program. Table 1 shows a small extract which compares new software for a modified V6 Holden against a standard program. The modified engine featured a new camshaft, higher compression ratio and bigger valves.

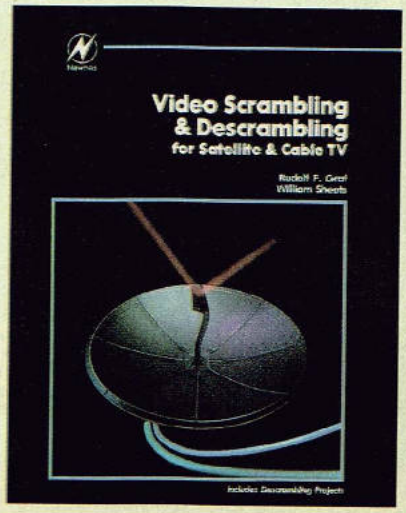
The program revisions were carried out by Awesome Automotive in Adelaide using the DynoCal software package. Awesome Automotive can be contacted on (08) 8277 3927, while KAL Software (Brad Host) is on 0412 266 758. SC

BOOKSHELF



Video scrambling & descrambling for satellite & cable TV

Video Scrambling & Descrambling for Satellite & Cable TV, by Rudolf F. Graf and William Sheets. Published 1987 by Butterworth-Heinemann. Soft covers, 215 x 278mm, 246 pages. ISBN 0 7506 9945 0. Price $34.95.



Even though Pay TV is now a (loss-making) reality in Australia, there is still considerable interest in satellite TV reception by virtue of the greater variety of programs and the fact that no monthly rental fees are payable. However, quite a few satellite broadcasts are scrambled and naturally there is dearth of information about the techniques involved. This book sets out to answer many of the questions although the authors stress that they in no way condone the misuse of the information. And while it was first published in 1987, the techniques of scrambling and encryption have not changed much since then.

I should say at the outset, that while reading this book may give you a good understanding of the various techniques used in video scrambling, it probably won't be of much help if you wish to do some unauthorised descrambling on an encrypted satellite signal. On the other hand, if you wish to be able to scramble and unscramble video for your own use, then this book could be very useful.

It has 12 chapters devoted to scrambling methods. The first two chapters start with the basic methods such as video inversion, sinewave addition and sync alteration and proceeds to digital techniques which even involve pixel scrambling. Chapters 3 & 4 become more specific, with circuit examples.

Chapter 5 covers the SSAVI system which stands for Sync Suppression and Active Video Inversion. Chapter 6 discusses the VideoCypher system. Chapter 7 is devoted to political, legal and consumer aspects of scrambling which will be of little interest to technical readers.

Chapter 8 continues with digitising of audio and video signals. Chapter 9 is of particular interest with cable and satellite decoders, and working circuits are included. Chapter 10 covers the VCII and BMAC (used in Australia) systems.

Chapter 11 is of general interest, talking about satellite TV signal strength and interference and finally, chapter 12 covers the DES (Data Encryption Standard) algorithm. Chapter 13 is devoted to semiconductor data sheets and chapter 14 covers three relevant US patents on the subject of scrambling.

In short, a very interesting and useful text. It will be available to order from the SILICON CHIP office. Phone (02) 9979 5644. (L.D.S.)

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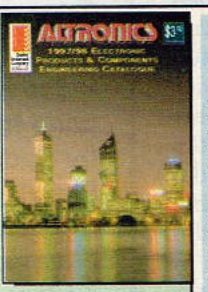

The ALTRONICS 1997/98 Electronic Engineering Catalogue is OUT NOW!

If you don't have yours yet,call

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for your ***free*** copy!

- **212 pages**
- **Dozens of exciting new products**
- **Expanded product data and specifications**

Dome Tweeter 2-for-1 Bargain

These super responsive **25mm soft dome tweeters** provide exceptionally smooth top end response for hi-fi and home theatre speaker systems. If you're building you own system or replacing worn out old tweeters, these may fit the bill! 8 ohms, 30 Watts RMS.

Amazing 2 for 1 Offer! SAVE 50%!

C 3002 Normally $35 each,

NOW **2** For **$35**

5mm LED Pack

1/2 Price LEDs! *Stock up your parts bin SAVE $$$!*

Back by request, this pack contains **100 MIXED** 5mm LEDs in red, green, orange and yellow colours. Stock up your parts bin or grab some for your own kits! ***BE QUICK, these won't last!***

Z 0002 5mm LEDs Pk 100, Value $25

NOW Only **$12.50**

Speaker Wire

ONLY .25¢ A METRE!

MASSIVE Savings!

High specification medium duty (14/0.18) figure 8 speaker wire on 100m rolls. Ideal for hi-fi systems, extension speakers, car audio etc.

W 2105 Normally .45¢ a metre,

NOW **$25** per 100m roll,

or buy **3** rolls for **$60**

Attention Boating Enthusiasts!

2 Way Marine Speaker System

Features "eyeball" tweeter mount for optimum sound field adjustment!

Fantastic for boating enthusiasts with an ear for fine music, our Opus One Marine series coaxial system is also the answer for outdoor installations normally subject to high weather corrosion. • Sturdy PVC frame • Powder coated white aluminium grill • Polypropylene cone • Polymide tweeter is swivel mounted for high frequency focussing • Easy to install with integral swivel clamps • Massive 80W max power handling.

Excellent sound reproduction - definitely amongst the finest weather resistant speakers we have tested.

C 0872 Normally $169 a pair,

NOW ONLY **$129** A Pair

Sturdy PVC Frame and Aluminium Grill. Excellent outdoor speaker system!

19" Rack Shelves

SAVE up to 20% on Rack Shelves!

These ingenious rack shelves are ideal for mounting traditionally desk standing equipment into a 19" rack frame. Great for CD's, tuners, amps etc. Industrial strength black powder coat finish, includes special rear support to keep equipment in place.

Cat. No.		Useable Depth	Height	WAS	WINTER SPECIAL
H 5352	2U	340mm	76mm	$49	**$39**
H 5353	3U	340mm	120mm	$55	**$45**
H 5363	3U	400mm	120mm	$64	**$54**
H 5354	4U	340mm	164mm	$59	**$49**
H 5364	4U	400mm	164mm	$69	**$59**

Crimping Tool & FREE Wire Strippers

Bonus Strippers Valued at $22.95!

BONUS OFFER!

This professional quality crimp tool is a fantastic addition to your technical tool kit. With proper care, it will virtually last a lifetime! *FOR JULY ONLY, while stocks last, buy the T 1552 Pro Crimp Tool, and receive a set of T 1522 automatic wire strippers, valued at $22.95, FREE!* A perfect combination for alarm installers, car audio techs, auto electricians etc! Crimp tool suits red, blue and yellow size connectors. Ratchet action and all metal construction.

T 1552 Plus BONUS T 1522

ONLY **$54**

1500W Switchmode 12V / 240V Inverter

Massive 1500 Watts Output! *Ideal for Remote Home Power Systems. Will Power a wide range of appliances, including Fluoro Lights & Microwaves.*

This inverter provides up to a massive *1500W* of 240V power from a heavy duty 12VDC car or truck battery. Switchmode circuitry eliminates bulky and heavy output transformers, making this unit very lightweight compared to similar inverters. It's suitable for a wide range of applications such as remote homes, sail and power boats, building or mine sites, off road vehicles, caravans, farms etc.

Features: • Over temperature & overload shutdown • Auto fan cooling • Low battery warning & shutdown • Heavy duty leads • Twin outlets • Weighs only 3.6kgs

M 8140 Normally $995,

Introductory Price ONLY **$795**

SUPER SPECIAL! SAVE a HUGE $200!

Rack Frame Super Special!

Due to a slight slip-up by our metalwork supplier, these racks have incorrect side panel mounting holes. ***But*** since 80% of our customers don't use side panels on their racks frames, this could be the *bargain of the year!* For those who wish to use a panel set on these racks, they can be fitted with only a few minutes work with a drill and file, *still a massive saving!* We have *STRICTLY LIMITED* stocks of these rack frames, so *BE QUICK!*

BARGAIN! *Ideal for PA racks, Hi-Fi systems, nightclubs, bands, etc*

Sorry, not available from dealers!

SUPER SPECIAL!

HA5509 9 Unit Rack, Normally $159, NOW **$89**

HA5512 12 Unit Rack, Normally $169, NOW **$99**

CD Carry Wallet

Made from heavy duty fabric with internal padding, this Compact Disc carry case will keep up to 20 of your CDs organised and dust-free. Each CD has a separate protective sleeve, and the case is a fraction of the size of 20 hard cover CDs!

Keeps up to 20 CDs protected and clean in a compact, easy to carry package!

A 9250 ~~$14.95~~,

NOW **$9.95**

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OVERNIGHT DELIVERY

Polypropylene Speakers

These fantastic speakers are ideal for replacement speakers or your own designs. Manufactured to our own specifications, these drivers feature low Q, high efficiency and low resonance, all a must for bass-reflex bass enclosures. From the punchy 6.5" driver to the mind-blowing bass of the 15", they deliver high-end performance without the huge price tags of our competitors. Ideal for 2, 3, or 4 way systems, or as component subwoofers in home hi-fi, A/V and car audio systems.

		Watts Max	Qts	Vas Litres	Fo	Normally	This Month
C 3055	6.5" Woofer	50W	0.43	27	40Hz	$29.95	$20
C 3060	8" Woofer	100W	0.32	54	34Hz	$59	$40
C 3065	10" Woofer	100W	0.28	173	28Hz	$79	$50
C 3070	12" Woofer	150W	0.17	367	25Hz	$99	$65
C 3075	15" Woofer	200W	0.33	461	28Hz	$139	$95

SUPER SPECIAL! SAVE 30%

13.8V DC 5A Power Supply

This rugged supply delivers a *regulated* 13.8V DC at up to 5A intermittent, or 3A continuous.

M 8250 Normally $110, NOW Only **$99**

Fully regulated 13.8V output! Ideal for CB's, tape recorders portable TV's etc

Electret Mic Insert *Clearout*

These electret inserts have a sensitivity of between 48 and 56dB, slightly lower than our standard C 0170 insert, which has 61dB sensitivity. They're fine for kits, FM bugs, FM radio mics, voice recorders and the like. Pick up a bundle and save *HEAPS!*

Normally $2.20 each

CX0170 Pack of 20 inserts **$10**

CX0171 Pack of 100 inserts **$39.95**

NOTE: All inserts in packs of 100 have the same sensitivity

That's only .50¢ each! Great for FM bugs, kits, digital voice recorders, etc.

Variable Temperature Soldering Iron

Excellent for professional users

Tip temperature is adjustable from 250°C to 450°C. Select the right temperature for the job and avoid heat damage to sensitive devices! Features ceramic heating element and supplied with T 2431 1.6mm conical tip. 3 other tip sizes available. See 1997/98 Cat page 111.

T 2446 Normally $49.50, NOW **$30**

Push Button Switch

We've scoop purchased these general purpose single pole momentary push button switches, and we're offering them at a ridiculous price! They're rated at 1A @ 125VAC and require a single 7mmO mounting hole. As used in our own kit sets and products! ***Normally $1.00 each.***

SUPER SPECIAL

SB1060 SPST Momentary Push Button

Pack of 10 Only **$4**

Pack of 100 Only **$30**

Hookup Wire

Rolls of heavy duty (24/0.20) *mains rated* hookup wire. Here's a chance to pick up some for the lab at a bargain basement price! Great for kit wiring, experimenting, auto wiring, etc. *We've even got mains colours available!* 100m rolls, rated at 300VAC, 7.5A.

Normally .40¢ per metre, Now only .10¢ a metre in 100m Rolls!

VERY LIMITED STOCKS, BE QUICK!

W 0271 White
W 0273 Brown
W 0274 Green
W 0275 Blue

All **$12** per roll, *OR* buy one of each colour for ONLY **$40**

TITAN Remote Car Alarm

Save 15% on a comprehensive car security system!

Easily the Best Car Alarm We Have Ever Evaluated!

Secure your vehicle with this versatile *TITAN* car security system. Don't let car thieves make off with your pride and joy, install one of these security systems and save $$$ on comparable units. System kit includes alarm module, two remote controls, battery backup siren, shock sensor, valet switch, status LED, wiring harness and hardware. *Features:* • Two remote controls • Super Loud 127dB siren • Remote panic • Battery backup and tamper proof siren • Child proofing and anti intrusion alert while driving • User selectable exit delay and auto re-arming • User selectable arming/disarming chirp • Starter kill • Valet mode • Automatic shunt of defective entry zone • Alarm memory indicates which zone (1-3) triggered • 60 second siren with auto reset • Two colour LED indicator • Can be interfaced with central locking (where fitted) • 3 extra channels on remote to control other vehicle features such as boot release, etc.

S 5205 Normally $199, NOW **$169**

3 Way Crossover *Clearance!*

SAVE 75%!

We're clearing out our 3 Way 150Watt hi-fi crossovers. Crosspoints are 800Hz and 5kHz, at 12dB per octave. Just the shot for your home-built speaker system!

HURRY! THESE WON'T LAST!

C 4009 Was $49, NOW **$15** ea or **2 for $25**

STRICTLY Limited Quantity!

75Ω TV Coax

SAVE 60%!

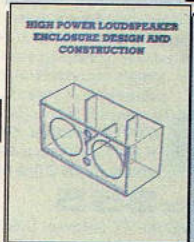
High spec 75Ω coaxial cable as used in in TV antenna installations, RF leads, test or patch leads etc. *Continuous 100m rolls.*

LIMITED STOCKS!

W 2222 Normally .90¢ a metre, NOW **$35** per 100m roll

ONLY .35¢ A METRE!

Loudspeaker Construction Book



This book includes comprehensive plans and background info for you to construct your own PA bins for DJs, bands or REALLY big hi-fi systems! The designs are used worldwide in nightclubs, concert halls, and even stadiums. This is a comprehensive reference and includes useful information on the different types of enclosures, how to obtain optimum sound distribution in a PA setup, enclosure design theory and construction, plus plans for 27 speaker designs from top-end horns to thunderous twin 15" W-bins! 166 pages.

B 2307 Normally $24.95, This Month **$19.95**

Mini Drill Set

Ideal for making one-off PCBs or prototypes!

One of the most powerful mini drills we've seen! Great for drilling PCBs, polishing, engraving, etc

A fantastic addition to any hobbyist tool kit, this powerful mini drill comes complete with a DC plugpack adaptor, four grinding stone bits, a cutting disc, four chucks (0.5, 1, 1.5, 2.4 and 3mm) and 5 PCB drills (0.5, 0.8, 1, 1.2 and 1.5mm). It's lightweight yet torquey enough to handle some really tough jobs! Great for drilling and trimming PCBs, engraving your valuables, model making, polishing gems or jewellery, custom instrument panel work etc.

T 2300 Normally $59.95, NOW **$49**

Toroidal Transformers

Save up to 60%!

We have *STRICTLY LIMITED* quantities of selected toroidal transformers available, and *they will NOT last at this price!* Great for amplifiers, power supplies, etc.

BE QUICK!

M 3080 45 + 45V 160VA	**$40** ea
M 3071 35 + 35V with 15 + 15V Aux. 160VA	**$40** ea
M 3088 25 + 25V 300VA	**$40** ea
M 3100 40 + 40V 300VA	**$40** ea
M 3120 30 + 30V 500VA	**$50** ea

2MHz Digital Function & Sweep Generator

Arguably one of THE most versatile pieces of test gear, sweep generators are used to obtain the frequency response of a device eg. an amplifier on a cyclic basis, so that the waveform can be observed on a CRO. This high spec 2MHz function generator has variable sweep rate and width, and also operates as a standard waveform generator with sinusoidal, triangle and square wave outputs, all with variable DC offset and symmetry at up to 10V p-p amplitude into 50Ω. Output frequency is adjustable via a front panel dial over seven ranges. The unit also features a 2MHz 4 digit frequency counter with external BNC counter input, making it a formidable piece of test gear!

Features sweep & waveform generator AND a frequency counter!

See 1997/98 Cat. p104 for details

Q 1560 Was $495, NOW **$445**

WINTER SPECIAL! SAVE $50

Q 0175 CRO Probe to Suit $39.95

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ALTRONICS COMPONENTS

Fax Order Line: (08) 9328 3487

RF Signal Tracer Kit

(See SC June '97) When servicing AM radios or CB radios, you'll need an RF probe to trace a signal through the RF section right up to the detector. This kit, complete with screened Packtec case, combines the functions of an RF probe and a mini Bench Amp. It allows you to probe the RF circuit and listen to the signal present. It's a fantastic, low cost service tool for technicians, hobbyists and enthusiasts, and is also a great way to discover how RF circuits work. Powered by a 9V battery (not included).

K 2566 **$24.95** NEW!

Sound Level Meter Adaptor Kit

(See SC Dec '96) This kit is a useful instrument for measuring sound intensities from 20dB to 120dB, and is plugged into a standard digital multimeter. It features A, C, and unweighted (flat) response filters, with slow, fast and peak reaction times. An ideal piece of test equipment for the audio engineer or installer. Flat response from 28Hz to 50kHz (-3db). Powered by two 9V batteries (not included). The ideal companion to the K 2592 Pink Noise Generator, which can be used to accurately calibrate the system.

K 2590 **$55**

Pink Noise Generator Kit

Use it to accurately calibrate SPL measurements! A must for the audio engineer!

(See Jan '97) Pink noise is used to calibrate audio systems to a particular sound level before they undergo frequency response checks eg. real time analysis, or just simply as a sound level calibration tone. Pink noise sounds like a roaring water fall, and contains a wide spectrum of audio frequencies. This kit has a 60mV output with a -60dB pad switch, and is connected to the audio system's power amplifier. Requires 9V battery (not included).

K 2592 **$24.95**

SPECIAL OFFER!

To properly calibrate SPL measurements, you'll need a Pink Noise Source. *THIS MONTH*, buy both the K 2590 SPL Adaptor AND the K 2592 Pink Noise Generator kits for only $63.95 and SAVE 20%!

EPROM Emulator Kit

Save time and money by EMULATING your EPROM during prototyping!

(See EA Dec '95) This EPROM emulator allows you to do away with EPROM's whilst in the prototyping stage of product development. The emulator is connected to a spare parallel port on your computer and also the 'target' board. The EPROM file (that is normally downloaded into the EPROM), is then transferred into the emulator by copying the file to the parallel port. This process saves repetitively "blowing" new EPROM's with each modification to the program. Emulates 2764, 27128, 27256 and 27512 EPROM's.

As Featured in December '95 Electronics Australia

K 9530 **$149**

Remote Control Volume Kit

Control your stereo volume from the comfort of your armchair!

(See EA July '96) This kit uses an infra-red transmitter and receiver and a motor driven pot to enable you to control the volume of your amp or preamp from anywhere within 5m line-of-sight of the receiver. Build it into your home-built amplifier or preamp for a professional finish. Includes case for the remote transmitter.

K 5024 Normally $45, NOW **$39**

The SCREECHER Car Alarm Kit

A low cost but effective theft deterrent for your vehicle!

A very simple, yet effective deterrent to car theives. Controlled by a hidden switch inside your car, this alarm will sound an ear-piercing 110dB piezo siren inside your vehicle when tripped, making life very uncomfortable for anyone there! Features exit and entry delay, with a soft three second pre-warn in case you forget to deactivate it, a super bright LED warning lamp and two trigger inputs. A budget alternative to commercial car alarms!

K 4360 Normally $29.95, NOW **$24.95**

Alphanumeric LCD Module Kit

(See SC May '93) Using an alphanumeric LCD display board is not as hard as you may have thought. This kit is certainly the easiest way of learning about these devices. Simply connects straight to your printer port of your PC. Requires K 2827 software.

WINTER SPECIAL ONLY! The K 2824 includes a *40 character by 2 line* display!

WINTER BONUS!
K 2824 Includes A Huge *40 Character by 2 Line* Display!

K 2824 **$55**

K 2827 3.5" PC Software Disk **$14.00**

Programmable TV Pattern Generator Kit

(See SC June/July '97) A high spec colour TV pattern generator, based on the Analog Devices AD722 RGB-to-PAL encoder and featuring an internal EPROM for storing the sync and pattern information. The standard patterns stored digitally on the EPROM supplied with the kit can be customised using a PC computer. Standard patterns are dot, crosshatch, circle, checkerboard, red raster, white raster, colour bars and greyscale bars, all meeting PAL standards. It also features direct video and RF modulated outputs with an option for an S-video output, and a provision for an input on the modulator to test the audio signal. A must-have for TV service personnel, build this invaluable piece of test gear and save $$$ on commercial units!

NEW!

An essential piece of TV service gear, NOW with EPROM based digital precision!

K 2715 **$139**

ALTRONICS
174 Roe St. Perth W.A. 6000
Phone (08) 9328 1599, **Fax** (08) 9328 3487
MAIL ORDERS C/- P.O. Box 8350
Perth Business Centre, W.A. 6849

We welcome ... bankcard MasterCard VISA

Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $9.50, 3kg to 5kg is $16.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs. **Insurance:** As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance". **Altronics Resellers:** Chances are there is an Altronics Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

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WOODRIDGE	David Hall Elect.●	(07) 38082777
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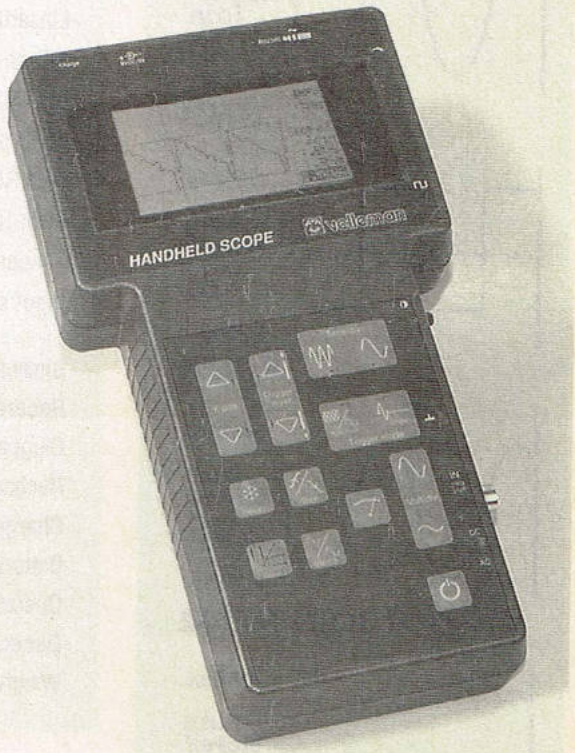
A handheld LCD oscilloscope

There have been a number of handheld multimeter/oscilloscope instruments produced in the last few years but most of them have been priced well above what the average technician or hobbyist could afford. This new unit made by Velleman is much more affordable.



All told, this new instrument has a surprising number of features packed into its compact 600 gram (excluding batteries) package. The case dimensions of 230 x 130 x 43mm allow it to be comfortably held in the average hand. When fitted with six AA rechargeable batteries it will operate for up to five hours or it can be powered from an external 9V DC 300mA plugpack. Its full specifications are listed in Table 1.

The unit boasts a full auto setup function which means that any signal can be connected and immediately a stable waveform is displayed. Not only this but the period and frequency of the input can be read from the righthand side of the LCD panel. As well, the meter function button can select one additional readout, either of the waveform's peak-to-peak voltage, RMS voltage, signal level in dB or DC voltage.

While the waveform display area itself is rather tiny (50 x 40mm) it gives a good portrayal of most waveforms. All functions are controlled by membrane switches on the front panel and these are more or less self-explanatory for anyone who has used an oscilloscope previously.

A red pushbutton labelled Markers switches four different backgrounds on the display. The first is a plain background, the second provides a dot grid with 5mm spacing which, on the display, is 9 dots across by 8 dots high. The third provides centrally located X and Y axes and the last has two pairs of cursors which can be moved to make peak-to-peak voltage and period measurements.

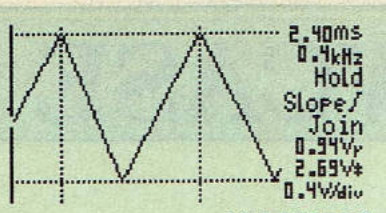
The Y position buttons move one of the P/P cursors while the trigger level buttons move the other. By positioning them at the maximum and minimum of any waveform the peak-to-peak value can be read. Similarly, by using the Time/div and Trigger mode buttons, the period between any two points on the waveform can be measured.

Getting back to the oscilloscope functions, the BNC input has an impedance of 1MΩ and 25pF which is similar to many oscilloscopes. A small slide switch below the BNC connector lets you select AC or DC coupling for the input signal and the input sensitivity is controlled by the adjacent Volt/div pushbuttons. To increase the sensitivity of the input amplifier you push the button with the big sinewave on it, while pushing the button with the small sinewave reduces the sensitivity.

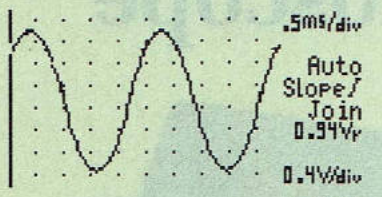
Below the input buttons is the normal on/off pushbutton. If this is used to turn the unit on it will turn itself off about eight minutes after the last keypress. If this is not convenient, the unit can be turned on permanently by using the Markers key.

If the scope is to be operated manually (as distinct from the auto setup mode) then the Time/div buttons operate like a normal scope, with the Trigger mode buttons allowing normal, auto or single sweep operation. Another button toggles the trigger from positive edge to negative edge, with the two buttons above it letting you move the trigger point amplitude up and down.

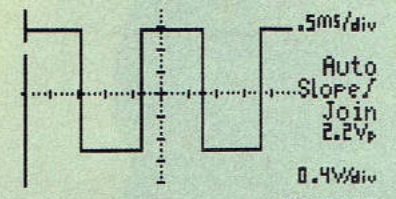
The only controls we still have to mention are the Y position, Dot/Join and Hold buttons. The Y position controls only operate in manual mode because, as we explained previously, in Auto mode they move the cursor. The Dot/join button does just that. It allows the display to show the digitised values as dots, or in the join mode it connects all the points, dis-



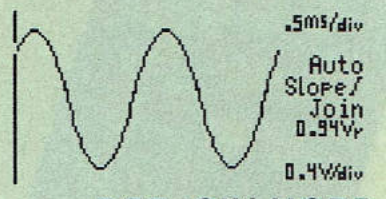
MARKERS



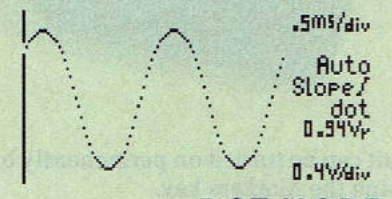
GRID



RULER



DOT JOIN MODE



DOT MODE

This series of screen shots show a number of operating features of the Velleman HHS5 handheld scope. The top screen shows a waveform bracketed by vertical and horizontal cursors for peak to peak & frequency measurements. The second screen shows a sinewave with a true RMS readout. The trigger level is indicated by a break in the lefthand vertical axis line. A dot grid is also displayed. The third screen shows a square wave with peak-to-peak readout and centrally located horizontal & vertical axes. The fourth screen shows a sinewave in "dot join" mode while the fifth screen shows the same waveform in "dot" mode.

Table 1. Technical Data

Maximum sample rate	5MHz for repetitive signals; 0.5 MHz for single shot signals
Input amplifier bandwidth	750kHz (-3dB at 0.4V/div setting)
Input impedance	1MW // 20pF
Maximum input voltage	100V peak (AC+DC) 600V with 10x probe
Input coupling	DC, AC or ground
Vertical resolution	8 bit (6 bit on LCD)
Linearity	±1 bit
A/D converter accuracy	±2 bit
LCD graphics	64 x 128 pixels, 64 x 96 for signals
dB measurement (0dB = 0.775V)	from -73 to +40 ±0.5%
True RMS range (AC only)	0.1mV to 80V, 2.5% accuracy
Peak-to-peak and DC range	0.1mV to 180V, 2% accuracy
Timebase range	20s, 10s, 5s, 2s, 1s – 10ms, 4ms, 2ms/div
Input sensitivity	5mV, 10mV, 20mV, 50mV, 100mV – 2V, 4V, 8V, 20V
Sinewave generator	400Hz 1V RMS max (adjustable)
Square-wave output	400Hz 3.5V p-p
Plugpack voltage	9V DC 300mA
Rechargeable batteries (opt.)	6 AA, 750 or 900mAh
Charge time	14 hours
Battery operation	5 hours (900mAh)
Operating temperature	0-50°C
Dimensions	230 x 130 x 43mm
Weight	600 grams (excludes batteries)

playing the conventional continuous trace we are more familiar with.

The Hold control freezes the display, allowing you to examine any particular aspect of the waveform. As well, it lets you send a digitised data stream of the displayed signal to the RS232 port on a computer. The information is sent as a table of 96 samples, each having a value between 0 and 255 as well as the Y sensitivity and the zero reference value.

This information could be used by a spreadsheet or Basic program to process the details of the display in any required manner.

One unusual but welcome feature of this instrument is the inclusion of a circuit diagram and PC board parts overlay in the back of the manual.

Our only complaint was that the righthand edge of the LCD display was covered by the front panel mask and we could not read the last digit of the readout. We could also see the lefthand silver edge of the LCD surround but not the righthand one. When we opened the case we found that the perspex mask was held in by two pieces of sticky tape. Removing this mask, rotating it 180° and replacing it cured the problem completely.

Perhaps the only real drawback of this scope is the limited bandwidth of 750kHz. Having said that, it is true that the majority of measurements that need to be made in most situations are normally well below this frequency.

On the positive side, the advantages of true RMS measurements and auto setup along with all the other features make this unit an attractive purchase for the technician or hobbyist.

The recommended retail price of the unit is $449 and it is available from all Jaycar Electronics stores. (R.J.W.)

Fast slewing operational amplifier

Analog Devices has introduced the industry's fastest slewing monolithic operational amplifier. The current feedback AD8009 features a 5500V/µs slew rate, more than twice that of its nearest equivalent, with 10% faster rise and fall times at 725ps for a 4V step.

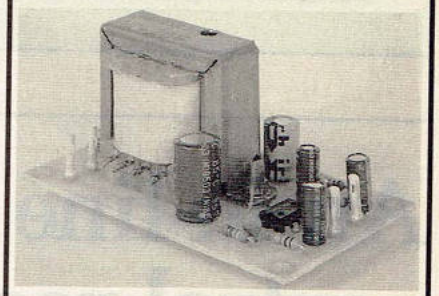
As a simple gain stage or buffer amplifier in high frequency instrumentation or in high speed test gear (as a pulse amplifier where a combination of high slew rate and low distortion is needed to inject signals of high integrity), the AD-8009 outperforms all other devices. Small signal (-3dB) bandwidth is 1GHz at unity gain and 700MHz with a gain of +2.

Dynamic performance is excellent: spurious free dynamic range is 74dBc at 5MHz, 53dBc at 70MHz, and 44dBc at 150MHz. For multi-tone signals, such as RF/IF signals, the 3rd order intercept is specified at 26dBm at 70MHz and 18dBm at 150MHz. Settling time to within 0.1% of full scale signals is 10ns.

For further information, contact Hartec, 205A Middleborough Rd, Box Hill, Vic 3128. Phone 1 800 335 623.

AUDIO MODULES

broadcast quality



Manufactured in Australia
Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

25W external power supply

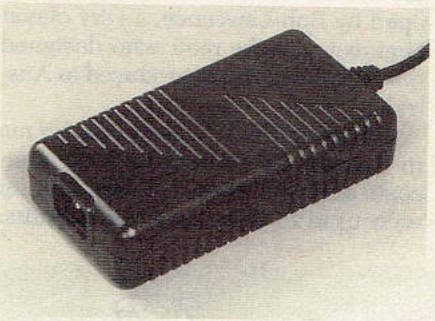
Today's electronic equipment can encounter a myriad of approvals and assessment before it can be put on the market. Usually the two main hurdles are safety and EMI. Amtex Electronics have attempted to overcome the majority of these by introducing the SCL25 series of external switching power supplies.

The SCL25 series are fully approved, carrying local office of energy and Austel approvals, and soon to carry the new C-Tick mark. As well, they carry international approval, such as UL, CSA and VDE for safety, as well as FCC and CE for EMI noise.

The SCL25 series come in a sturdy moulded plastic case. The input is 90-264VAC via an IEC input socket and single output voltages ranging from 5VDC to 48VDC are available, as well as dual and triple output units of 5V and ±12V or ±15VDC. Output is via an 8-pin mini-DIN or 2.5mm jack plug.

The units also feature an output LED indicator, regulation of ±4% and up to 60ms hold up time.

For further information, contact Amtex Electronics, Power Supply Division, 2A Angas St, Meadowbank, NSW 2114. Phone (02) 9809 5022; fax (02) 9809 5077.



1200V fast recovery diode modules

IXYS Corporation has announced the availability of the MEK 75-12DA fast recovery diode module in the industrial standard TO-240 package. It consists of two matched, 1200V rated, 75A(avg), fast diodes with common cathode connection.

The two epitaxial diodes have low reverse recovery current and short reverse recovery time (t_{rr} = 450ns maximum at T_J = 100°C) and they exhibit soft reverse voltage recovery to minimise EMI.

The two diodes may also be connected to operate in parallel due to their matched on-state voltage drops. The modules have an isolation voltage rating of 3000V (RMS) and are UL recognised.

Major applications for these diode modules include rectifying the AC output from high-frequency inverters.

For further information, contact GEC Electronics Division, Unit 1, 38 South St, Rydalmere, NSW 2116. Phone (02) 9638 1888; fax (02) 9638 1798.

Rugged 600V IGBT

BBS Electronics has released rugged versions of Harris Semiconductors' ultrafast switching IGBTs rated at 600V and 20A at 110°C. These new devices allow motor-controller designers to replace power transistors with IGBTs to maximise efficiency (due to IGBTs' lower conduction losses), without redesigning their present short-circuit protection circuits.

This series of devices has a short-circuit withstand time of 10µs, the maximum for any IGBT, at 440V and 150°C. Because Harris rates SCWT at 150°C instead of 125°C, designers can use smaller heatsinks.

For further information, contact BBS Electronics Australia Pty Ltd, Unit 24. 5-7 Anella Ave, Castle Hill, NSW 2154. Phone (02) 9894 5244; fax (02) 9894 5266. **SC**

RADIO CONTROL

BY BOB YOUNG

An in-line mixer for radio control receivers

This month, we will look at a simple 2-channel in-line mixer for use with R/C systems that are not equipped with mixers in the transmitters. This can be used to control two servos together when complex models are involved.

This mixer was to have been the ultimate "simple job" – take a through-hole design that has been in production for 20 years and convert it to surface mount components, greatly reducing the size in the process. No electronic redesign, no black magic RF or other issues to get underfoot, just relay the PC board. Pretty simple, right? . . . WRONG!

The original unit was designed for Silvertone in the golden years before tariff reductions cut the heart out of the business. This mixer was developed by Bob Lawrence, a very clever engineer and the man who designed the last television set produced in Australia.

Bob consulted on many jobs for me in those days, even though the concepts and challenges I presented him with used to drive him to his limits. The only thing that kept Bob Lawrence coming back for more was the fact that the jobs we gave him were so interesting.

Now I look back and shudder and wonder what possessed me to undertake some of the jobs I became involved with. There were 32-channel robotic puppets, radio-controlled full-size motor vehicles, R/C machines six stories high, 80-tonne R/C shot blast trolleys and RPVs, to name just a few.

Years later, I lost touch with Bob and have not seen him to this day. By now you are all asking what on earth has all this to do with this column? The fact is that when the first prototype SMD mixer refused to work I found myself wishing that Bob Lawrence was still around. It is a very clever little circuit and quite tricky to service.

That night I went home and who should be on the TV (Good Medicine) telling the story about the great new breath test for Heliobacta Bacillus (the bug often associated with ulcers)? . . . none other than Bob Lawrence (Bob, if you read this I would like to hear from you).

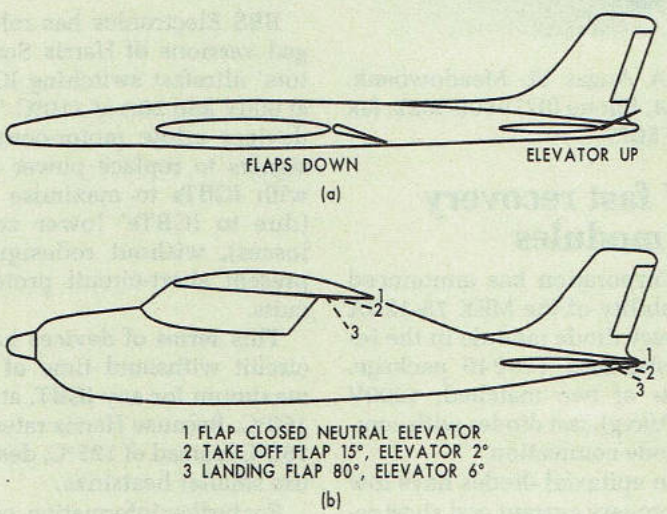


Fig.1(a): mixed elevators/flaps are used for aerobatics or as compensation for trim shift. Fig.1(b) shows elevator trim compensation for the pitch changes that takes place when the takeoff or landing flaps are selected.

Reversed inputs

As it turned out, I did not need Bob's help for I discovered after hours of hair-tearing effort that the Protel schematic library component for the 3900 op amp has the input pins reversed. This meant that the PC board was wrong and that I had no hope of making that mixer work. I also checked the new Protel for Windows (Advanced PCB) and found that the error was in that library as well. I have enormous confidence in the Protel Autotrax system and never once ques-

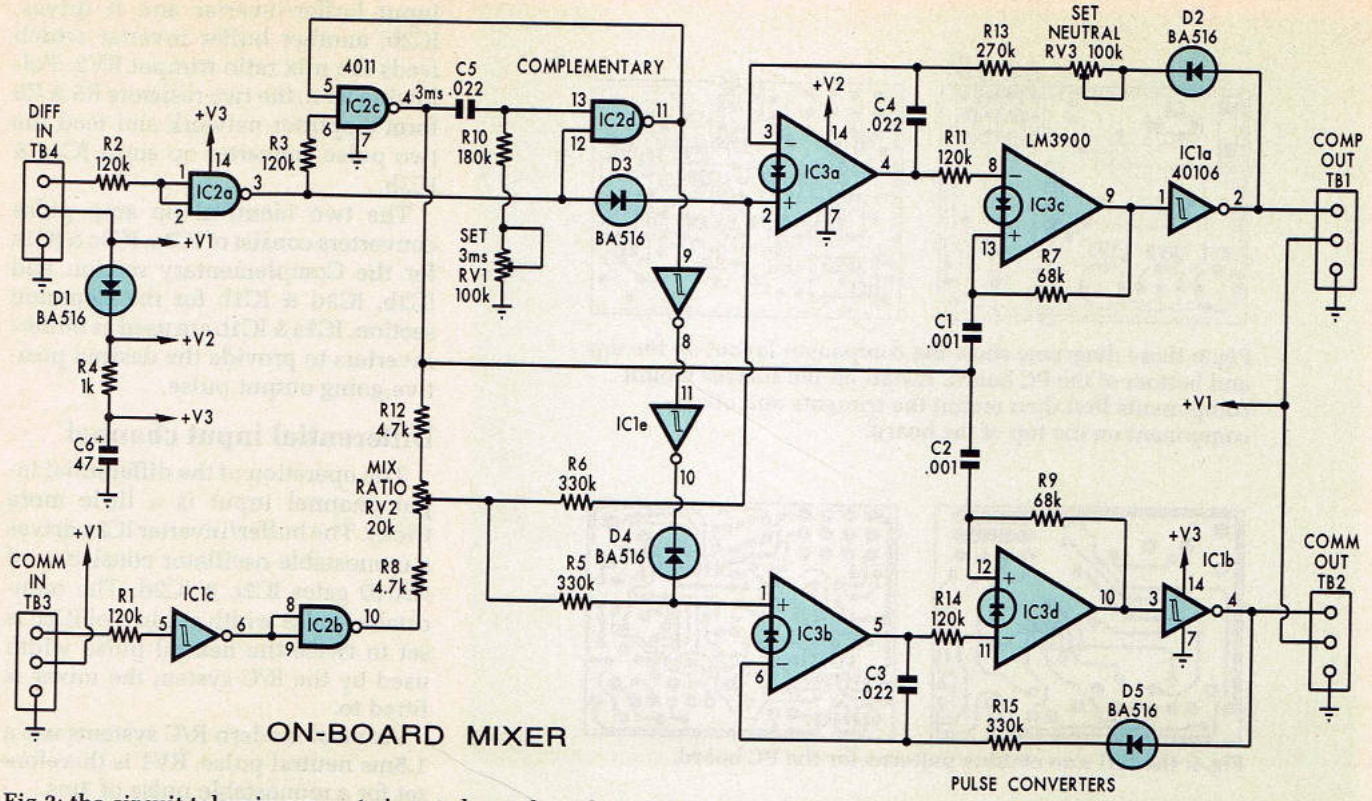


Fig.2: the circuit takes in separate input channels and converts them into two separate composite signals, Common out and Complementary out. Mixing is set by trimpot RV2.

tioned the schematic or PC board. It was only after I had exhausted all other avenues that I had to look further. I might add that this is the first time that Protel has ever let me down.

The second prototype worked perfectly once I had corrected the schematic library and located the solder bridge I had created across two of the pot pins (even the experts do it). So much for the so-called "simple job".

Mixing concepts

For those not familiar with the concept of mixing as applied to R/C transmitters, see the article entitled "The mysteries Of Mixing" in the December 1995 issue and the October 1996 issue which featured the "Multi-Channel Radio Control Transmitter; Pt.8". These articles give a full and detailed explanation of the intricacies of electronic mixing of flight controls. Whilst these articles deal mainly with mixing in transmitters, the principles still apply to add-on mixers for receivers.

Briefly, mixing is the coupling of controls so that moving one control results in one or more servos operating simultaneously in ratios and directions preset by the operator.

Common applications include elevons for tailless aircraft, collective and tail-rotor pitch for helicopters, and coupled aileron/rudder and flaps with elevator compensation on fixed wing aircraft. Less common are twin screw boats and tracked vehicles which incorporate speed and steering by the common/differential use of throttle.

As you can see, mixing is a very important feature, making models simpler to operate and the modern R/C transmitter reflects this with all sorts of mixing features built in. Unfortunately, such features usually come with a built-in high price tag as well.

However, owners of older transmitters without mixing may fit an in-line mixer in the model itself and this will work almost as well. I say almost because usually two functions are the maximum available in an in-line mixer. Transmitters with electronic mixing usually allow multiple point mixing but as most applications use 2-point mixing this is not a serious disadvantage.

Setting up an in-line mixer can be a tricky business, especially with transmitters without servo reversing so I should repeat some of the October 1996 article dealing with setting up for delta mix.

Before proceeding any further, there is a very important point to bear in mind when setting up mixing functions. Each mixer input has an additive effect on servo throw and this must be taken into account when setting mix ratios. Failure to observe this may result in the servo being driven into its internal mechanical end stops with attendant gear damage. Therefore, be sure to check the final servo travel with the full extremes of mixing applied, as servo travel varies with the brand of servos used and the transmitters used.

An illustration

To illustrate the point being made in the above warning, let us examine the mixing process for a delta aircraft featuring elevons (delta mix). Such an aircraft uses two control surfaces, one on each wing and each control surface performs two functions, aileron and elevator control; hence the name elevon.

The diagram of Fig.1 shows the control sequence in detail.

To bank such an aircraft, one control surface goes up and the other goes down, thereby imparting a rolling

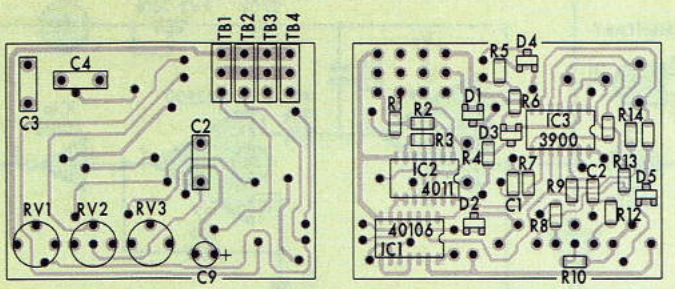


Fig.3: these diagrams show the component layout on the top and bottom of the PC board. Install all the surface mount components first then mount the trimpots and other component on the top of the board.

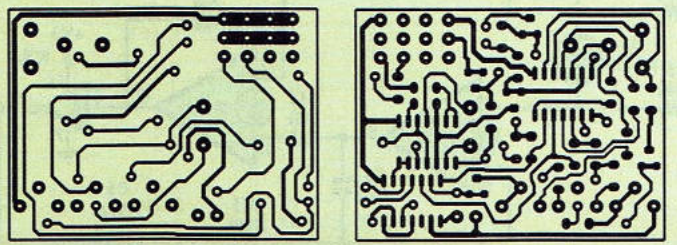


Fig.4: the full size etching patterns for the PC board.

motion to the aircraft. For pitch control, both control surfaces go up to raise the nose and down to lower the nose.

Complications arise when one wants to bank and climb simultaneously. If full throw on the aileron servo gives the desired rate of roll what happens when we then apply full up elevator to impart a climbing motion to the aircraft?

If we are turning left then some UP mixed into the right elevon (which is DOWN in a left roll) is easily accommodated. However, there is no more travel available in the left servo which is already full UP. To apply an additional pulse width variation will only drive the servo hard into the end stops and possibly strip the gears.

Therefore, the controls must be mechanically arranged so that 50% differential servo travel (one UP, one DOWN) gives the maximum rate of roll and 50% common servo travel (Both UP or DOWN) gives the maximum pitch angle.

Then we may apply full pitch and roll commands simultaneously. Oddly enough, at this point only one servo actually moves and it goes to full travel. The two commands on the opposing servo cancel each other out and the servo remains in neutral. Elevon controls are very complex controls to set up correctly, especially when you start to consider the reflex and unequal differential angles which must be taken into account for the correct aerodynamic conditions required by tailless aircraft.

Circuit description

The full circuit is shown in Fig.2. Briefly, the circuit takes in two separate input channels and converts them into two separate composite signals. The primary input is defined as the common input and it must come first in the input channel transmission order. For example, if we are mixing for elevons (aileron/elevator) and the transmitter channel order is Aileron, Channel 1 and Elevator, Channel 2, then the common input is plugged into the Aileron Channel.

It is for this reason that the common input lead must be clearly identified on the finished mixer. A short piece of heatshrink tubing shrunk onto the lead just behind the servo plug does the trick nicely. It is a good idea to similarly mark the common output as an aid to testing.

The operation of the common input is fairly straightforward. IC1c is the input buffer/inverter and it drives, IC2b, another buffer inverter which feeds the mix ratio trimpot RV2. Following RV2, the two resistors R5 & R6 form a splitter network and feed the two pulse converter op amps IC3a & IC3b.

The two identical op amp pulse converters consist of IC3a, IC3c & IC1a for the Complementary section and IC3b, IC3d & IC1b for the Common section. IC1a & IC1b are used as buffer/inverters to provide the desired positive-going output pulse.

Differential input channel

The operation of the differential input channel input is a little more tricky. The buffer/inverter IC2a drives a monostable oscillator consisting of NAND gates IC2c & IC2d. The monostable pulse width at pin 4 of IC2c is set to twice the neutral pulse width used by the R/C system the mixer is fitted to.

As most modern R/C systems use a 1.5ms neutral pulse, RV1 is therefore set for a monostable pulse of 3ms.

This 3ms pulse is used to generate the complement of the differential channel in IC2d using the gating action of the 4011. Thus if the differential channel moves to 2ms then the complement is 1ms. Likewise, if the differential channel moves to 1ms then the complement is 2ms. At neutral both input pulses are set to 1.5ms, therefore the complement is 1.5ms.

The common control pulse and the 3ms pulse are added in RV2 to produce a composite with a variable ratio but constant sum. Diode D3 gates out the control pulse part of the 3ms pulse so that the sum of the common pulse plus the complement of the differential pulse is applied to the pulse converters to produce the complementary output pairs.

The final composite outputs are a true mix of both input channels. Thus the differential channel adds to the common output channel and subtracts from the complementary output channel in a ratio again set by the mix ratio pot RV2. As a corollary, the common input adds or subtracts from both outputs in equal amounts, again in a ratio set by RV2.

The range of the mix is set by R8 & R12. As the operation of the mixer becomes non-linear beyond 80-20%, I suggest using 75-25%. This is more than adequate for the real world.

Where To Buy A Kit Of Parts

The inline mixer module is available as follows:

Fully assembled module complete with servo leads $69.50

Complete kit with PC board and servo leads $49.50

PC board only $11.50

When ordering, purchasers should nominate the R/C system they are using. Postage & packing for the above kits is $3.00. Payment may be made by Bankcard, cheque or money order to Silvertone Electronics. Send orders to Silvertone Electronics, PO Box 580, Riverwood, NSW 2210. Phone/fax (02) 9533 3517.

Inside the suggested range the mixer holds neutral to within 5% over a temperature range of 10°C to 50°C and a voltage range from +4V to +5.2V.

RV3 is a balance control to set the neutral on the second servo. The neutral on the first servo may be set by the complementary pot RV1.

Diode D1 performs a dual function. Firstly, it protects against reverse polarity. Secondly and more importantly, it drops the rail voltage to +4.2V. This is an important point for compatibility with imported sets, particularly with some of the newer sets that have output pulse voltages under 3V. CMOS chips need the input to exceed one half rail voltage for reliable switching.

Resistor R4 and capacitor C6 provide a supply decoupling network for IC1 and IC2. IC1f in the 40106 hex inverter is unused.

Board construction

Construction is very straightforward, with surface mount components used for maximum reliability and minimum size. If you have not worked with surface mount before then once again I would suggest reading "Working With Surface Mount Components" in the January 1995 issue of SILICON CHIP.

Install the surface mount components first and the through-hole components next. Fit the servo leads, remembering to slip the short piece of heatshrink tubing over the common input and output leads before soldering them into the PC board.

Testing

First, set up the transmitter trims to neutral and plug two servos into the channels to be mixed to ensure that both servos are on neutral. Set all mixer control pots to mid range and plug the input leads into the receiver and the servos into the mixer servo sockets. Adjust trimpot RV1 to neutralise the servo in the common output. Set the neutral on the servo in the complementary output using RV3.

Now move the transmitter sticks first in one axis and then the other, checking to ensure that both servos travel in approximately equal amounts on each axis. Moving the common axis stick will result in both servos moving in the same direction. Moving the differential axis stick will result in the servos moving in opposite directions.

This of course assumes that both servos rotate in the same direction without the mixer. It may be necessary to reverse one servo to get the correct direction of rotation on both outputs.

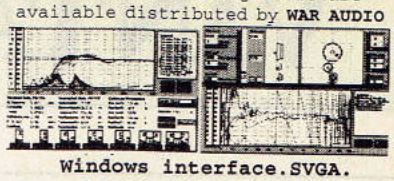
Now wind the mix ratio pot RV2 fully anticlockwise. One stick axis should barely move the servos, whilst the other should give almost full travel in both servos. If this checks out, wind RV2 fully clockwise and ascertain that the opposite is true. The full travel axis should now be reduced to almost zero travel whilst the reduced travel axis should now deliver almost full range.

One small warning here. If the trims are not on exact neutral the servos will appear to move off neutral as the ratio of mix is increased. This is deceiving for what is actually happening is that the servo movement is increasing and moving the servo away from its original position. This is most noticeable if the ratio of mix is changed when the throttle channel is one of the mixed channels and the throttle stick is at one end of its range.

That's it – you are now in business. Add the case and go and fly. SC

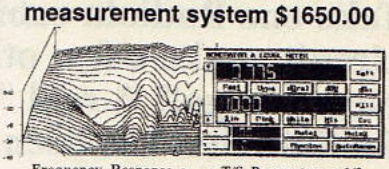
SOUND EASY V2, BOXCAD V2
BY BODZIO SOFTWARE

Comprehensive s/design software available distributed by **WAR AUDIO**



Windows interface.SVGA.
Box modelling , 7 type enclosures, 10 alignments for box optimizer, Box time response, Room placement, Import Clio, Lms, Imp, Mlissa etc, Crossover modelling , Optimizing , D'APPOLITO modelling and much more. BOX CAD includes complex impedence and electrical modelling and more. $350.00 upgrades from $60.00.

Clio Professional electro-acoustic measurement system $1650.00



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TENS unit for pain relief

TENS stands for Transcutaneous Electrical Neural Stimulation and is widely used by physiotherapists for relief of chronic pain. This compact design offers variable pulse width, pulse rate (frequency) and variable voltage output. It is battery operated for safety.

On sale 30th July Australia-wide

*Note: the preparation of these articles is well advanced but circumstances may change the final content.

VINTAGE RADIO

By JOHN HILL

Revamping an old Radiola

Take one Radiola cabinet, add an Airzone circuit, make a few other alterations and what have you got? A real "bitzer", that's what! This Radiola that has been completely reworked but, despite that, it still looks the part.

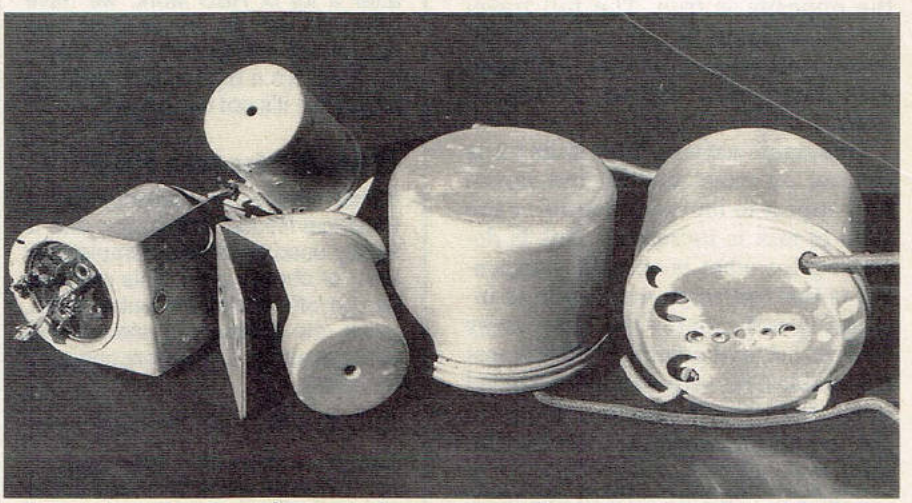
In the November 1992 issue, I described how an old 1935 battery-powered Radiola was converted to 240V operation. It was a big job as far as I was concerned, for the simple reason that I had never tackled such a project before. What's more, I didn't know how successful the conversion would be until the job was completed.

The set was originally built from parts salvaged from two wrecked receivers, both of which were battery models. Some time later, a better cabinet was found and so the old Radiola ended up being rebuilt from three separate receivers.

The conversion to AC required the almost complete stripping of the chassis – not even the valve sockets could be used in the rebuild! The only original components that were retained were the dial, the tuning capacitor and its associated coils, the two 175kHz IF transformers, and the permanent magnet loudspeaker.

Retaining the permag speaker may seem an odd approach to an AC conversion since mains-powered receivers used electrodynamic types in those days. However, there were good reasons for keeping it. The cabinet could use only a particular type and size of speaker. Because the heads of the speaker mounting bolts are exposed at the front of the cabinet, moving the bolts to accommodate another speaker was out of the question.

As it turned out, the 60-year-old permag speaker worked amazingly well and kept up with anything the single type 42 output valve could throw at it. While there was some apprehension about using the speaker during the construction stage, it soon proved itself once the set was operational. As an added bonus, the speaker actually looks like an electrodynamic type and it requires a close examination to see the difference.



All the original coils and IF transformers were discarded when the old Radiola was rebuilt. They were replaced with more modern components.

Dial drive problems

Restoring any vintage radio receiver to working order is often fraught with problems. One particular headache with the Radiola was the friction drive dial mechanism, a common fault with many old receivers. Having two to choose from didn't help much as each one was as worn and useless as the other.

The only practical solution was to completely modify the tuning mechanism and the friction drive was replaced with a more conventional cord drive setup. This amounted to adding a drum and a suitable control spindle, specially made to do the job.

Converting a battery receiver to AC operation and altering a useless friction drive to a cord type seemed to be a logical approach to the problems at hand. But not everyone agreed with my line of thought.

Apparently, some vintage radio collectors were horrified at such desecration and I received a few critical letters as a result. The debate about the set's originality continued off and on for about two years before the matter was finally laid to rest. Apparently, vintage radios should be restored exactly as they were originally made, without alterations to circuits or devi-

ous modifications. Well, so I'm told!

Unfortunately, that's not always possible. Beside, I like to restore an old receiver in a manner that suits me and I base my decisions on such things as cost, the availability of parts and other practical aspects of getting a derelict old radio working again.

It is interesting to note that during the war years thousands of 1930s vintage battery receivers were converted to AC operation. As new receivers were unavailable at the time, converting battery sets to AC operation became a booming business. It's strange that such a conversion was OK then but not the done thing today.

Major rework

Since then, the Radiola AC conversion has undergone a major rework. No doubt it will please my critics to know that I haven't chosen another set to convert, so hopefully I won't draw any further flak from those opposed to such things. It's just an extension of the previous modification.

The incentive for the rework came about because the old Radiola developed an odd intermittent fault. Sometimes it would work normally, while at other times it would not. And when it played up, part of the broadcast band would move off the low-frequency end of the dial.

While the fault was obviously caused by a considerable shift in oscillator frequency, the problem could not be corrected by tapping components or waggling connections. Whether or not it worked properly was a decision that only the receiver made, depending on its mood.

After several unsuccessful attempts at locating the elusive intermittent fault, a big decision was made. The whole chassis was stripped with the exception of the tuning capacitor, dial mechanism, and power transformer. It was then rebuilt using fresh components.

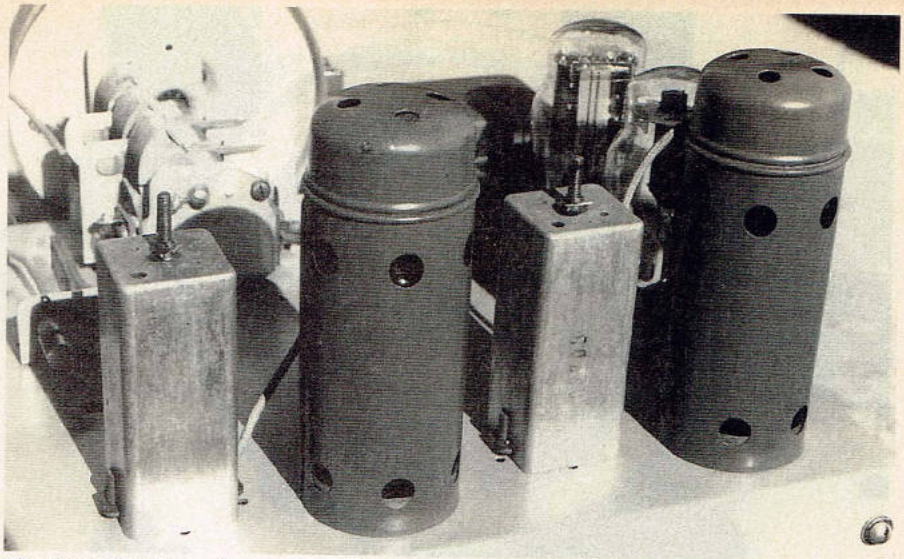
The last time this was done, an Airzone 517 circuit was used to build the detector and audio stages. This time the whole circuit was used. The Airzone 517 is nothing special; just a fairly standard late 1930s broadcast band 5-valver with simple AGC and octal valves. My version, however, used pre-octal valves with similar characteristics.

There were also a few alterations to the circuit. For starters, the local/distance and tone switches were eliminated, with a potentiometer being substituted for the latter. A high-tension choke was also incorporated to substitute for the nonexistent field coil. Previously, a 20W resistor had been used in the HT line but this resulted in a low-level hum in the speaker. While this hum was not intrusive, it has been virtually eliminated by the addition of the choke.

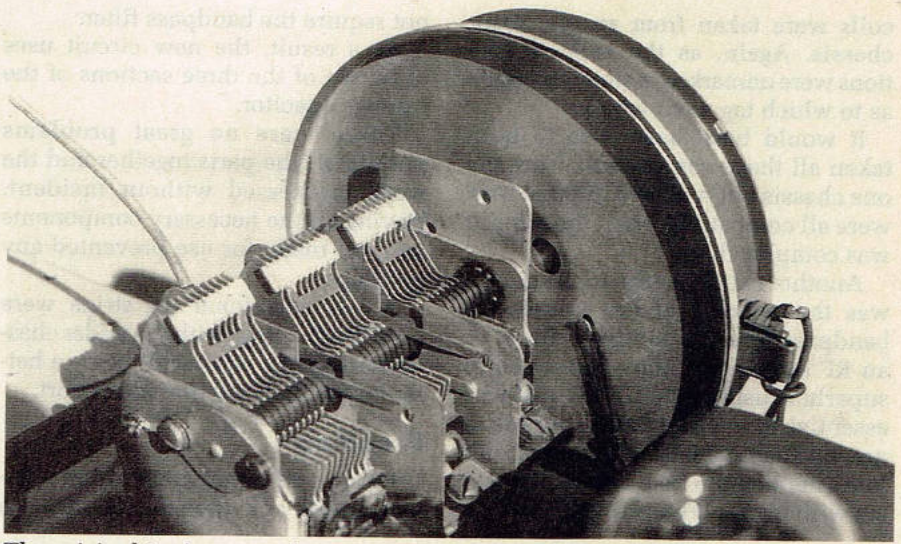
A pair of large postwar IF transformers were selected to replace the old 175kHz originals. These were chosen mainly for their size as everything about the old Radiola is big, the chassis being about 125mm high. The IF transformers were mounted on top of the chassis, as opposed to the underchassis mounting arrangement of the originals.

When these transformers were taken from their derelict receiver, the various connections were noted before disconnecting the wiring. They were also marked IF1 and IF2 because they bore different part numbers and so should not to be treated as interchangeable units.

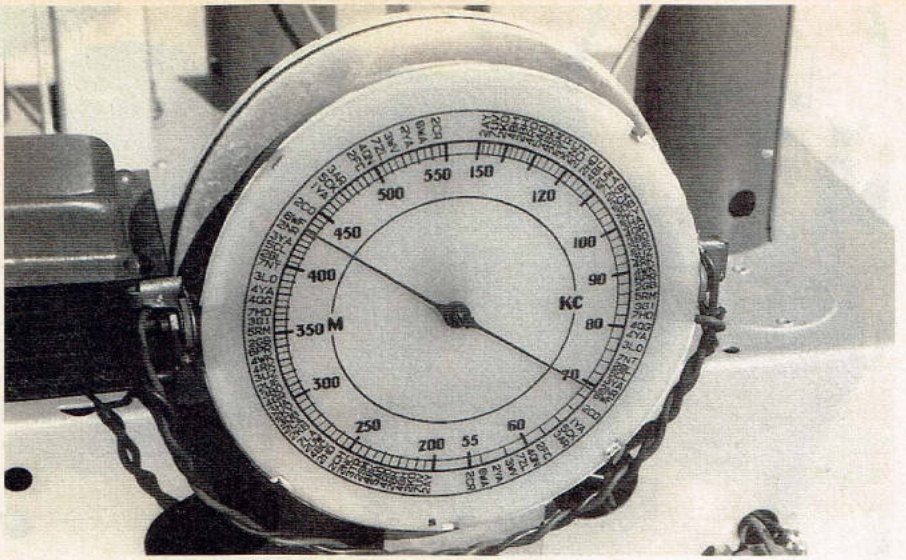
The air-cored aerial and oscillator



The "new" IF transformers are from a late 1940s Radiola and were mounted on the top of the chassis (the originals were mounted below). These transformers were chosen mainly because their large size seemed appropriate to the generous dimensions of the chassis.



The original tuning capacitor now operates on only two of its three gangs, as the preselector bandpass stage has been removed. Note the large diameter cord drum that has been fitted to the tuner spindle so as to incorporate a cord drive.



The dial used on the old Radiola is typical of AWA units from the mid 1930s. It is marked with station call signs around the outside, wavelengths in metres on the left, and frequencies in kHz (KC) on the right. The original battery-operated set had no dial lighting but this was added during the conversion to mains power.

coils were taken from an old Astor chassis. Again, as the coil connections were unmarked, notes were made as to which tag went where.

It would have been nice to have taken all these components from the one chassis but it turned out that they were all compatible when the rebuild was completed.

Another major change to the circuit was the removal of the preselector bandpass filter. A bandpass filter, or an RF stage, was employed on early superhets using 175kHz IFs and was essential to avoid double spotting, a natural characteristic of receivers with low intermediate frequencies. Receivers with higher IFs around 455kHz do not require the bandpass filter.

As a result, the new circuit uses only two of the three sections of the tuning capacitor.

There were no great problems putting all the parts together and the work progressed without incident. Having all the necessary components laid out ready for use prevented any hold-ups.

A few additional tag strips were used to advantage with the under chassis wiring, the end result being a better layout than my previous effort.

Problems

Using odd components from various makes and models can make a project of this nature somewhat difficult. While the IF transformers tuned OK to 455kHz, I encountered difficulties in getting the dial to track when aligning the aerial and oscillator circuits. Most of the broadcast band was there but the frequencies did not line up correctly with the dial.

This problem was eventually solved by adding more capacitance to the padder capacitor and attaching a 7pF capacitor to the oscillator tuning gang. After some juggling with the padder adjustment and the oscillator trimmer, the dial tracked quite well, being less than 10kHz out at its worst point of error. In the circumstances, that was better than anticipated.

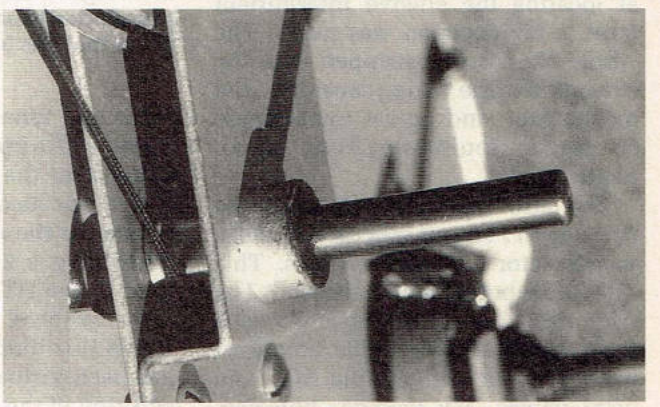
A good performer

It was only after the alignment had been completed and the chassis fitted into its cabinet that I realised that this was a really good receiver. Its ability to pull in distant stations was excellent and a number of Tasmanian stations came in loud and clear. The rebuilt Radiola-cum-Airzone receiver performed very well indeed.

It is probable that the original aerial, oscillator and preselector bandpass coils, plus the 175kHz IF transformers, left something to be desired with the initial conversion. Using early 1930s coils and IF transformers is not the best way to go about building a radio receiver. The components from that era are nowhere near as efficient as those from the late 1930s and 1940s.

By replacing these parts, the general performance has been greatly improved, particularly at the high frequency end of the dial.

This 60-year old AWA permanent magnet loudspeaker looks identical to the electrodynamic version. It is not the one from the receiver but is kept as a spare. It is also handy for on-the-bench testing when the chassis is out of the cabinet.



This photo shows the tuning shaft modification that was used to convert the slipping friction drive mechanism to a less troublesome cord drive. Why such a modification should be criticised by some collectors is beyond the author's comprehension.

While far from original inside, the old Radiola receiver still retains its vintage appearance. Its current performance is far in excess of that delivered by the original design, thanks to a complete circuit revamp. The three controls (from left to right) are: volume, tuning and tone.

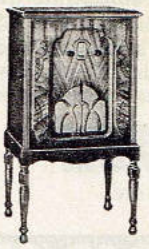
So once again the old Radiola has gone through a major transformation and the IF transformers on top of the chassis betray the extent of the modifications. But that's not a problem as far as I'm concerned because the alterations have been for the better. Upgrading to more modern coils and IF transformers has made a really big difference to the set's performance.

Little cost

In money terms, the initial outlay of $20 for the two battered receivers was not great and they have provided me with many hours of constructional pleasure. The cost of converting junk to an operational radio has been almost zero because all the necessary components were on hand.

Despite the various modifications and the replacement Airzone circuit, the reworked Radiola still looks an acceptable valve radio. Only vintage radio collectors familiar with that particular make and model would notice that the chassis is not what it really should be. **SC**

Vintage Radio



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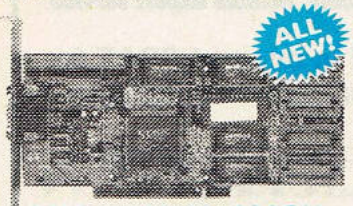

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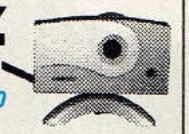

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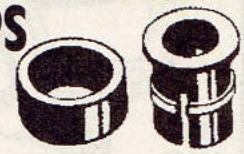

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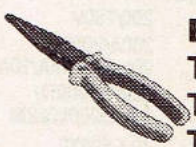

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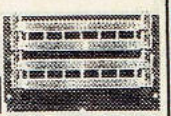


P10552 RIGHT FACING

P10553 LEFT FACING

1-9 **$9.95** 10+ **$8.95**

JURASSIC SELF ADJUSTING WIRESTRIPPER

A11531 **$5.95**

12V COMPUTER FAN

T12469

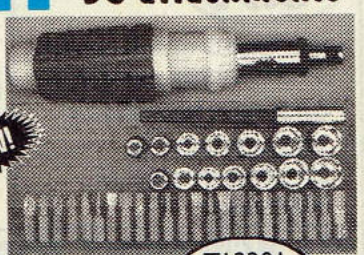
80mm/3.15"

Normally $14.95

1-9 **$9.95** 10+ **$8.95**

TOOL KIT -38 attachments

40 pieces Tool Kit with ratchet driver, adaptor and multiple bits. All packed in a plastic carry case.



NEW!

T12201 **$17.95**

- 1 Reversible Ratchet Driver
- ¼ Drive Adaptor
- 4 Magnetic Nut Setter
- 3 Slotted Bits- 5/ 6/ 7mm
- 3 Philips Bits- #1, #2, #3
- 2 Robertson Bits- #1, #2
- 8 Hex Bits- 1.5/ 2/ 2.5/ 3/ 4/ 5/ 6 & 6.5mm
- 7 Star Bits- T10, T15, T20, T25, T27, T30, T40.
- 7 ¼ Nut Driver Socket AF 3/16, ¼, 5/16, 11/32, 3/8, 7/16, ½.
- 7 ½ Nut Driver Socket MET 6/ 7/ 8/ 9/ 10/ 11/ 12mm

A COMPLETE VERSATILE TOOL SETS FOR HOBBYIST OR TECHNICIANS! KEEP ONE HANDY IN YOUR TOOLBOX OR CAR.

REMOVEABLE STANDARD IDE HARD DRIVE CARRIER

C11919

$79.95

SUPER INVERTOR

12 Volt DC to 230 Volt AC at 125 Watts continuous

UNBELIEVABLE VALUE FOR WHAT YOU GET!

M19034 **$129**

This unit is designed to supply a continuous 125 watts of power @ 230VAC 50Hz from a 10-13.8VDC power source such as a car battery. Fitted with an approved Australian AC socket for convenience makes it suitable for use with running CBs and portable Hi Fi systems, small TV sets, PCs and mobile phone chargers.

- DC input voltage:10-13.8VDC
- AC output voltage: 230VAC / 50Hz
- Power Output: Constant 125 watts
- Over current protection
- Over voltage protection
- Regulated voltage output

REMOVEABLE STANDARD SCSI HARD DRIVE CARRIER

C11917

$89.95

5-0 SURGE PROTECTOR POWER SUPPLY CABLE

Protect devices i.e.- • Hard disk Drive • CD-ROM Drive • Floppy Drives, etc.

P19067 **$24.95**

MULTI VOLTAGE PLUG PACK

500mA- 240VAC to 6/ 9/ 12VDC - regulated

M19009 ~~$29.95~~ **$22.95**

240 volt AC (50Hz) to regulated 6-9-12 volts DC convertor - output capacity of 500mA.

• Plugs into your existing mains wall socket • 1.8 metres cord with 1.0, 1.3, 2.1 & 2.5mm DC plug • Plug is easily removable which allows the polarity of the plug pack to be reversed as well as the size and type of plug used to be changed

12V DC FLASHING LED

S15087

Dash light

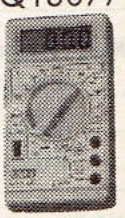
• Continuous visible flashing red LED light

• Car theft deterent

$4.95

BUDGET DIGITAL MULTIMETER

Q13077



The ideal meter for technicians with a full 3½ digit LCD readout. Requires a 9V battery either alkaline or carbon. Expected life of carbon battery is 100 hours and 200 for the alkaline.

1-9 **$17.95**

10+ **$15.95**

SPECIFICATIONS:

DC Voltage:	200mV/2/20/200/1000V
Basic accuracy:	+/-0.5%
Input Impedance:	1M
Maximum Input:	1000V DC
AC Voltage:	200/750V
DC current:	200A/2000A/20mA/200mA/10A
Resistance:	200Ω/2000Ω/20kΩ/200kΩ/2M
LCD Display:	15 x 46mm
Dimension:	70 x 126 x 24mm

500WATT SINEWAVE INVERTOR & BATTERY CHARGER

NEW!

M19033 **$699**

This invertor unit is designed to supply 500W of 240V AC power from a 24V car battery or a series of two 12V batteries. It even operates as a battery charger to the connected batteries! Output a super low distortion sinewave and is suitable for operating power sensitive equipments, such as: battery chargers, computers, etc. Can even be used as an UPS to provide power to computers systems, telephone exchanges or signalling systems. Incorporates heatsinking system and twin 240V 3 pins outlets in a sturdy metal case. Features loading power/battery status indicator.

Dimensions: 256 x 355 x 125mm.

- DC input voltage: 22-28VDC
- Max output 240V AC 500 watts

IDEAL FOR CAMPING, BOATS, TRUCKS, RVs, ALTERNATIVE, POWER INSTALLATIONS, ETC!

SC4879 AUW78

Plustek OpticPro 4830p
30-BIT (1 BILLION COLOUR) SINGLE-PASS FLATBED SCANNER
600 dpi resolution

- A4, 30-bit, 1 Billion colours, 600dpi, 4800 dpi interpolated
- Enhanced Parallel port with printer port pass-through for printer connection
- Software includes for Optical Character Recognition (OCR)-OmniPage LE OCR or TypeReader, PhotoMagic-Image editing

X19922 **$338** TAX EX
$399 TAX INC

PLEASE LOGON TO- http://www.rie.net.au for full specs for these scanners

POWER SUPPLY 0-30V 5AMP DC

Provides 0-30V DC regulated output at up to 2.5A. The output voltage is adjustable via the front panel controls. Fitted with 5V and 12V DC output connectors, at up to 500mA. It features Digital LCD voltage and current displays in a compact steel case measuring only 150 x 145 x 200mm. Stable, precise regulated power control is possible through the current limit LED. Power via 240V AC mains and features two 4mm banana socket output terminals.

M19037 **$199**

- DC input voltage: 0-30VDC
- Output current: 2.5A
- RMS: 5mV

IDEAL FOR R & D CENTRES, RESEARCH LABS, EXPERIMENTATIONS OR BREADBOARDS TESTING, ETC.

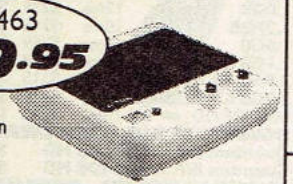
STEPDOWN TRANSFORMER 240-110VAC

Designed with quality in mind it provide a safe 250 watts of power to equipment operating on 110VAC. Fitted with 2 USA power sockets and an ON/OFF switch. Simply connect to any Australian 240VAC power outlet to use.

M19038 **$89.95**

- ON/OFF power switch
- Fitted with 1.8m AC cord
- Sturdy metal casing
- Over current protection
- Short circuit protection
- Replaceable fuse
- Input voltage: 240Va. c 50Hz
- Output voltage: 110Va. c 50Hz
- Dimensions: 200 (L) x 120 (W) x 95 (H) mm

VIDEO TAPE REWINDER



A11463 **$49.95**

Rewind your tape separately without interrupting your viewing. • Belt-driven • Spherical angle design • Fast rewind and forward with LED indicator • Noiseless operation • Auto stop & soft eject

MINI DRILL RECHARGEABLE

T12301 **$29.95**

Battery powered high speed mini drill

• Speed: 6000RPM • DC charge socket on the handle • With 3 chuck sizes, a drill bit, engraver and 2 grinders • Requires 6V/150mA charger i.e.: Plug Pack Multi-DC 150mA Unregulated- M19104 $17.95 from our Plug Pack range • Charger is for battery only- drill must be powered by battery

TOUCH PAD CONTROL

Throw away your mouse! Now you can control the cursor with greater freedom and minimal hand movement. Simply put your finger on this magic pad and point! • Super glide point magic touch pad designed to replace your mouse. • Effortless smooth tracking ensures the cursor goes exactly where you want it. • Simply connect to your COM port and use adaptors where needed. No software required.

Video Blaster IE500 Multimedia Internet Toolkit

"Internet Edition" Video Blaster IE500 is the first video capture from Creative for Pentium based PCI systems. Video Blaster IE500 captures single still frames or AVI movies at up to 30 frames per second at a resolution of 320 x 240 (AVI capture is dependent on CPU, hard disk and bus architecture of end-user's system). Video acquisition is software selectable from either a composite or S-Video input and supports NTSC-M, PAL-B/G and SECAM. Twain driver support is also included. Video Blaster can be used for Internet Video Conferencing with the included Creative Video WebPhone Personal Edition software. (Video camera is required for video component of software. Optional Desktop CCD camera is available separate see X17440). Also includes • Asymetrix Digital Video Producer • Creative AVI to MPEG Convertor • Family Album Creator • HoTMetal Light • ImagePals 2 Go! and Microsoft Internet Explorer.

ALL NEW SOUND BLASTER RANGE:

X17404	SB AWE64 VALUE INTERNETed	$199
X17432	Video Blaster IE500 Multimedia	$299
X17442	Internet Video Conferencing PCI	$499
X17444	SB CD Home 16/16x INTERNETed	$499
X17446	SB CD Value 16/12x INTERNETed	$369
X17448	SB CD 64/12x INTERNETed	$599
X17450	SB CD 64/16x INTERNETed	$699
X17452	Creative Infra Remote Controller	$39
X17370	3D Blaster 4MB PCI	$399
X17405	SB AWE64 PnP GOLD	$499
X17366	Portable TVCoder	$379
X17440	Creative Compact Video Conferencing CCD Camera	$249
X17438	SmartTV	$249
X17434	InfoWave IW9000 Wire Data Access	$499
X17436	NetWaveMX	$299

LOGON TO OUR WEB SITE- http://www.rie.net.au FOR FULL DETAILS

SUPER CAPACITOR

FARAD 5.5V
R15620
$6.95

EPROMS

STOCK UP WHILE THEY ARE CHEAP!

Cat No.	EPROM	1-9	10+
U20594	27C256	$8.95	$7.95
U20595	27C512	$8.95	$7.95
U20546	27C010	$9.95	$8.15
U20547	27C020	$14.95	$12.95
U20548	27C040	$29.95	$24.00

Microsoft Mouse

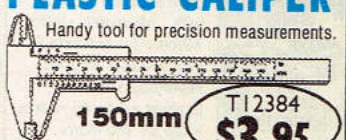
Mouse port PS/2 and Serial version. This is the Microsoft Mouse version 2.0. One of the most comfortable, accurate, and versatile pointing devices for the Windows™ operating system. The front-weighted ball, improved internal mechanism, and solid, tactile feeling gives you precise control of the cursor. Bundled with new Microsoft IntelliPoint Software that saves you time and extra hand movements by allowing you to assign repetitive mouse tasks to mouse functions.

X19958 **$139** NOW **$69**

TO USE THE MICROSOFT MOUSE YOU NEED:

- MS-DOS® operating system 2.11 or later
- Serial or PS/2- compatible mouse port.
- MDA, CGA, EGA, VGA, SVGA, XGA or VESA VCI-compatible video adaptor

PLASTIC CALIPER



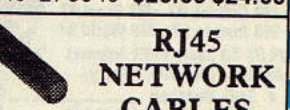
Handy tool for precision measurements.

150mm T12384 **$3.95**

FOOT PEDAL SWITCH
to 6.35mm plug 1 way

A17001 **$24.95**

Extra heavy duty foot switch push on push off operation. • Full metal housing • 2.5m cord with 1/4" jack plug on the end



RJ45 NETWORK CABLES

NEW LOWER PRICES!!

SOLD BY THE METRES-

	1-9	10-99	100+
W12683	$1.20	$1.10	$0.90

TRIALWARE GAMES

CD FOR ONLY $5 EACH!

WHERE ELSE CAN YOU SAVE ON YOUR INTERNET ACCESS DOLLARS AND STILL GET ALL THESE GREAT GAMES AT SUCH A PRICE?

VOLUME 1: • Monster truck Madness • Fire Fight • Close Combat • Hellbender • Marathon, etc.

VOLUME 2: • NBA Full Court Press • Diablo • HyperBlade • Amok, etc.

VOLUME 3: • The Neverhood Puzzles • Ace Ventura • Gex • Deadly Tide, etc.

VOLUME 4: • War Wind • Scorcher • Texd Bass Fishing II • MS Soccer, etc.

VOLUME 5: • Rocket Jockey • A10 Cuba • Broken Sword • Cricket 97, etc.

VOLUME 6: • MechWarrior II • Soul Trap • Full Tilt II • Rally Challenge, etc.

VOLUME 7: • F22 • Winter Race 3D • Jack Nicklaus • Age of Sail • Scarab, etc.

VOLUME 8: • Pod • Blade Warrior • Flight Unlimited • Goose Bumps, etc.

DON'T MISS OUT! GRAB YOUR COPIES!

ERRORS & OMISSION EXCEPTED. PRICE CHANGE WITHOUT NOTICE.

ALL NEW PRODUCTS & GREAT SPECIALS

Plustek OpticPro 4800p

24-BIT 16.8 MILLION COLOUR SINGLE-PASS FLATBED SCANNER *600 dpi resolution*

- 24-bit, 16.8 Million colours
- 600dpi, 4800 dpi interpolated
- A4 scanning area
- Parallel port, no jumpers to fiddle with!
- Software included for Optical Character Recognition (OCR) photo editing and multifunction document processing such as faxing and copying

NEW X19912 **$259** TAX EX **$299** TAX INC

PLEASE LOGON TO- http://www.rie.net.au for full specs for this scanner.

MONITOR SPLITTERS

4 WAY MONITOR SPLITTER X19167 **$249**
Connect 4 VGA monitors to 1 computer. Great for seminars, presentations, and schools.

8 WAY MONITOR SPLITTER X19165 **$329**
Connect 8 VGA monitors to 1 computer. Simultaneous display.

ETHERNET CABLES

For networking installation using BNC 50 ohm coax cabling that are preassembled ready-to-use cables with BNC connectors at both end.

BNC 50 ohm Network Cables:

Cat No.	Length	Price
P37700	500mm	$5.95
P37701	1m	$6.95
P37702	2m	$6.95
P37703	3m Male-Male	$7.95
P37705	5m Male-Male	$8.95
P37710	10m Male-Male	$9.95
P37715	15m Male-Male	$15.95
P37720	20m Male-Male	$17.95
P37730	30m Male-Male	$29.95
P37740	40m Male-Male	$39.95
P37750	50m Male-Male	$49.95

Microsoft Office 97

ALL BRAND NEW!

- MS PowerPoint 97
- MS Outlook 97
- MS Excel 97
- MS Access 97
- MS World 97

PLUS 50 hours FREE Internet Access - (Conditions Apply)

- **Full Version** $685
- **Professional Upgrade** $439
- **Standard Upgrade** $339

*MS Access is not included in the Standard Upgrade version

CLICK MOUSE

- Dynamic & fast tracking
- Opto-mechanical encoder

1-9 $7.95 10+ $6.95

JOYSTICK

- Ultra-sensitive fire button
- Turbo & manual switch
- 5 ft cord

1-9 $17.95 10+ $16.95

IOMEGA ZIP DRIVE

THE AFFORDABLE PERSONAL STORAGE SOLUTION

- 100MB Zip disks hold all your stuff
- Are inexpensive, reliable and ready to help you get organized
- Use as many disks as you need

Av Seek Time: 29msec

Available for IBM and Mac

Parallel Port version only C11900 **$249**

100MB ZIP DISK C11904 1+ $22.95 10+ $21.00

HOT SPECIALS

MODEM SALE

33.6K bps Internal	$129
33.6K bps External	$149
33.6K bps Int. Voice/Fax modem	$159
33.6K bps Ext. Voice/Fax modem	$169

All Modems Austel Approved
50 hours FREE Internet access when you purchase your modem from us!
(Ask for Conditions)

A4 LAMINATOR

LATEST A4 SIZE LAMINATOR

you can protect and preserve your favourite documents
- **up to A4 size,**

business cards, recipes, membership cards, and other types of paper thin objects in a waterproof, airtight seal.

$169 A91101

A91118 216 x 303mm (A4) **$89.00** PKT100
A91119 216 x 303mm (A4) **$12.95** PKT10

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All on display at all Stores

- 14" N.I. 1024x768 (0.28mm D.P.) **Full Scan** . $279
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- 15" XGA Digital OSD 1280x1024 ..... $379
- 17" XGA Digital MPRII 1280x1024 . $699
- 17" XGA Digital MPRII 1600x1280 (0.26mm Dot Pitch) $1295
- 20" XGA Digital MPRII *NEW!* $1895
- 21" XGA FLAT SCREEN *NEW!* $2795

OSD- On Screen Display
See our web site- http://www.rie.net.au for full specifications

BLANK CD-ROM DISKS

	1-9	10+	100+
C11909 **VERBATIM**	$10.95	$9.90	$8.00
C11960 **NO NAME**	$9.95	$9.00	$8.00
C11961 **KODAK GOLD**	$12.95	$11.95	$9.90

MS HOME ESSENTIALS 97

Everything you'll ever need to get things done at home on your Personal Computer!

Have more fun at home with... Microsoft- • Word • Works 4.0 • Encarta 97 World Atlas • Greeting Workshop • Internet Explorer • Arcarde • Fonts • Clip art and more!

RITRON COMPUTER SYSTEMS

CPU TYPE (External 256k Cache)	TAX EX	TAX INC
6x86-120/150P	$920	$1120
6x86-133/166P	$940	$1145
6x86-200P	$970	$1165
Pentium™ 120	$980	$1195
Pentium™ 133	$1015	$1235
Pentium™ 150	$1040	$1268
Pentium™ 166	$1160	$1415
Pentium™ 200	$1280	$1520
Pentium™ 166MMX	$1275	$1555
Pentium™ 200MMX	$1610	$1964
Pentium™ Pro 180	$1690	$2065
Pentium™ Pro 200	$1810	$2208

•8 MEG RAM •1.3 GIG H.D.D.-*GREAT VALUE!* •1.44 MEG 3.5 FDD •Mini or Baby AT casing •2 SPG Ports •104 Keyboard •14" SUPER VGA (1024 X 768) (0.28" DOT PITCH) Colour Monitor • Systems now fitted with PCI video cards - Better performance value for the same price. •*Pentium Pro system comes with 16MB of RAM and AT style case & P.S. ATX case & P.S. available as optional extra.*

FREE 3 HOUR *TRAINING COURSE (MELB ONLY) FOR ALL COMPUTER SYSTEMS INCLUDING MULTIMEDIA SYSTEMS*

4 YEAR SYSTEM WARRANTY
Manufacturer's Warranty apply for Monitor
3 Months Consumables Warranty

★RITRON CLASSIC★

The ideal system for today's power-hungry users...

32 MEG RAM WOW!

★ **18x-Speed CD-ROM drive**
★ **32 MEG** FAST EDO RAM
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- **430 HX M.B. $40 extra**
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★ **4 MEG S3 3D Virge Video Card**
★ **15" XGA Digital Mon-**1280 x 1024 0.28mm D.P. Low radiation
★ **2.1 GIGABYTE HDD**
★ **1.44 3.5" F.D.D.**
★ **Genuine Microsoft Ergonomic Mouse** ★ **Joystick**
★ **Ritron Mouse Pad**
★ **Windows 95 104 Keyboard**
★ **16-bit Sound Card -SB compatible**
★ **Magnetic Shielded Speakers**
★ **Windows 95 on CD** (DOS & Windows 3.11 for Workgroup available on request)
★ **We install Vet OEM Antivirus software** $99 of bonus value

★**BONUS 7 FREE CD SOFTWARE TITLES:** For Windows 95: Microsoft- Works & Money/ Encarta 97/Golf /CD Sampler / Cinemania 97 /3D Movie Maker /Scenes on disk and Yellow & White Pages on CD-ROM

★**100 Megabytes FREE** SHAREWARE GAMES

CPU CHOICES	TAX EX	TAX INC
6x86-133/166P	$1475	$1685
6x86-200P	$1555	$1735
Pentium™ 120	$1565	$1745
Pentium™ 133	$1585	$1785
Pentium™ 150	$1615	$1815
Pentium™ 166	$1715	$1935
Pentium™ 200	$1750	$1975
Pentium™ 166 MMX	$1785	$1995
Pentium™ 200 MMX	$2095	$2345
Pentium™ Pro 180	$2330	$2610
Pentium™ Pro 200	$2485	$2775
Pentium™ II 233	$3085	$3475

Pentium Pro's come with 32Meg of Ram as standard with AT style motherboard, case and power supply All Pentium™ Motherboards come fitted with 256K Pipeline Cache.

100 Hours Free Internet Access From rie.net.au - *When modem & system are purchased together. Conditions Apply*

★**NOW COMES WITH FREE** MS Windows 95 CD tutorial

FREE HOME DELIVERY & SETUP- MELBOURNE METRO AREA ONLY

3 HOUR FREE TRAINING COURSE Windows 95 OR Internet Training Classes available

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4 YEAR PARTS & LABOUR WARRANTY

ADD MORE MEMORY, POWER, AND HDD SPACE TO YOUR SYSTEM

SUPA MOTHERBOARD UPGRADES

	CPU	*M.B.	Both Together
AMD K5-133	$159	$145	$289
6x86-120/150P	$189	$145	$309
6x86-133/166P	$189	$145	$309
6x86-200P*	$269	$179	$429

*512K Cache Motherboard

- 120MHz PCI/ISA $319
- 133MHz PCI/ISA $349
- 150MHz PCI/ISA $429
- 166MHz PCI/ISA $499
- 200MHz PCI/ISA $599
- 166MHz MMX NEW! $695
- 200MHz MMX NEW! $995
- *Pro 180MHz AT MB $1049*
- *Pro 200MHz AT MB $1195*

HARD DRIVES *Voice Coil IDE HD*

Capacity	Av.Access	Tax Ex.	Tax Inc.
1.0GB	12ms	$235	$286
1.27GB	10ms	$245	$299
1.6GB	10ms	$259	$315
2.1GB IDE HD	10ms	$279	$339
2.5GB IDE HD	10ms	$315	$384
3.2GB IDE HD	10ms	$330	$399
5GB IDE HD	10ms	$550	$665

QUANTUM BIG FOOT DRIVES:

Quantum B.F. 4.3GB IDE HD	$449
Quantum B.F. 6.5GB IDE HD	$595

FAST SCSI 3.5" HARD DISK DRIVES SPECIALS

2.1GB SCSI 2 HD	SPECIAL	$450	$545
3.2GB SCSI 2 HD	SPECIAL	$490	$595

ALL DRIVES HAVE 3 YEAR WARRANTY

MEMORY

	1-9	10+
1M 30 pin	$15	$13
4M 30 pin	$49	$45
16M 30 pin	$239	$225
4M 72 pin	$45	$43
4M 72 pin EDO	*$39*	*$35*
8M 72 pin	$75	$69
8M 72 pin EDO	*$59*	*$57*
16M 72 pin	$135	$129
16M 72 pin EDO	*$115*	*$110*
32M 72 pin	$239	$229
32M 72 pin EDO	*$219*	*$215*

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- 12x-Speed $289
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- 18x-Speed $319
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With easy-to-follow installation instructions. All CD-ROM drives are Kodak PhotoCD® compatible. • 16-bit Sound Card • Stereo Speakers • Software titles: For Windows 95: Microsoft- Encarta'97/ Works & Money/Golf/ CD Sampler/ Cinemania 97/ 3D Movie Maker and Scenes on disk. *ALL NEW!!*

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- *8X-SPEED* $149
- *12X-SPEED* $149
- *16X-SPEED* $169
- *18X-SPEED* $179
- *24X-SPEED* $239
- *8X-SPEED SCSI* $339

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SYDNEY: 74 Parramatta Rd, Stanmore. Ph: (02) 9519 3888 Fax:(02) 9516 5024

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NTSC-to-PAL converter enquiry

I have an 8mm NTSC camcorder and I would like to use it to record on a PAL-standard VCR. Can I use the NTSC-to-PAL converter published in the May 1997 issue to do it? I note that there was a comment about this converter not being suitable for recording from the NTSC format to PAL but I am hoping you can tell me how it might be done. (A. K., Yass, NSW).

• Well, we hate to give negative answers but you can't use the NTSC-to-PAL converter for recording. The problem is that the converter does not change the field frequency of 60Hz to suit the PAL standard of 50Hz. While most video monitors and TV sets can quite happily cope with the difference, a PAL VCR cannot. It must have a TV signal with a field frequency of 50Hz.

No vibrato in Digital Effects Unit

I have a Digital Effects Unit, as described in the February 1995 issue, in for repair. The fault is no vibrato. On basic checking I note that there is no output at pin 7 of IC1d when the Effects switch is in and Echo off. Further tracing of audio via headphones revealed a 1kHz tone at pin 24 with Vibrato off and a switching noise with Vibrato on. Any comments? (A. B., Wollongong, NSW).

• The 1kHz tone and noise at pin 24 of IC1 is correct. The fault is probably in the signal path of the delay unit IC3. Check the switching to IC3 at S3a and S3b. Also there could be a short or open circuit connection to S3a from IC3.

24V to 12V conversion for truck accessories

I have a 24V truck. It has a 12V air horn set, a 12V CD player and a 12V alarm system. The current drain ranges up to 3.5A. The horn doesn't get used much at all. Neither does the CD player now but the alarm is armed for a considerable portion of the day, draining one battery. I swap the batteries around every month but what I require is a 24V-12V regulated supply to suit. Can you help? (C. S., Napier, NZ).

• Unfortunately, there is no one project which will satisfy all your requirements. The 24V/12V speed control published in the June 1997 issue will drive your 12V air horn, assuming that it has a motor driven pump. And as far as your CD player and 12V alarm are concerned, the best way to power them would be to use the 24V-12V converter published in the December 1987 issue. While no longer available as a kit, all the parts and the PC board are obtainable.

More queries on shunting meters

I see you answered an enquiry about shunting meters last month. I have a similar problem. I have a 1mA 200Ω meter movement that I want to measure currents up to 10mA. I can see the general method but I am uncertain about the result I get.

Is a shunt resistor of 20Ω correct for my application? (B. B., St Andrews, NSW).

• You have followed the procedure outlined last month but you have neglected the 1mA current drawn by the meter itself. Perhaps we did not make that point quite clear, although it was alluded to. In essence, you want 10mA to be read by the meter and so the total meter and shunt resistance should carry that current at full scale deflection. If you allow for the 1mA current drawn by the meter itself, that means that the shunt must carry 9mA.

Now we know that the meter is 200Ω so that must mean that the voltage across it (the "burden" voltage) is 200mV for 1mA FSD. Therefore we want a shunt resistor which will carry 9mA with 200mV across it. Using Ohm's Law, R = V/I = 200mV/9mA, we get an answer of 22Ω which is convenient because it is a preferred value.

40W inverter must use name-brand semis

I would like to relate a recent experience I had concerning the 40W Inverter published in the February 1992 issue of SILICON CHIP. At switch on, it clattered into life, then promptly died! The 5A fuse was open, so I replaced it with an 8A type. As I had used the larger 60VA transformer, I simply put the fuse failure down to that.

I say "failure" as the fuse had not blown violently. When I measured the no-load output I had 210VAC; nothing like 279VAC as stated in the article. With a 40W load, this dropped to a crazy 185VAC. The output was terrible, virtually useless. The lamp was flickering at a rapid rate, almost going completely off, then on again. This effect lasted about five minutes, after which the inverter "died" again.

Instead of using a flat metal plate as the heatsink, I used a proper finned type. It was incredibly hot, much more so that it should have been. I suspected a circuit fault, a not so uncommon failing these days. But it was *not* that at all, I'm pleased to relate. When I bought the necessary components, I purchased more than needed to make up a spare parts kit. The inverter is for a friend of mine in Goulburn and the parts could be very difficult to find in that town.

I was aware that MTP3055A power FETs were unsuitable for this circuit, so I made sure that the ones I had were the right type (the "E" version). However, I suspect they were substandard. They were made in Mexico. The pair in the spare parts kit, ironically, had a

Multimedia & dual diversity

I have questions on two separate topics. Recently my son completed construction of the Multimedia Amplifier described in the October & November 1996 issue of SILICON CHIP. However, before inserting the power link, the voltage on pins 1, 3, 4, 6 & 9 of all three power ICs was 0V not 6V as stated in the article.

We have thoroughly checked the board for solder bridges, incorrect insertion of polarised components, etc and cannot determine what the problem is if there is one at all. Currently we are stalled with speakers assembled and the board constructed awaiting connection of the "power links" but unsure if it is safe to do so. Any ideas as to the likely cause of the missing voltage or if it is safe (for the computer especially) to connect the power links as is.

Second, in August & September 1994 you published articles describing a diversity tuner for FM microphones. It comprised a single tuner with an antenna switching circuit to select the better reception from one of two antennas rather than use two receivers. Is it possible to adapt the antenna switching circuit to an existing non-diversity VHF (200MHz) FM microphone receiver to reduce drop out etc? (G. C., Hazelwood Park, SA.

• We're afraid that there is an error with the test procedure. You were the first to let us know. Without the link installed, pins 1 and 9 measure about 0.5V and pin 7 measures 12V. No voltage is present on the other pins. With the link in, pins 1 and 9 measure 2.2V, pins 3, 4 & 6 measure 5.6V and pin 7 measures 12V.

While it is possible to adapt the Dual Diversity antenna switching circuitry to an existing 200MHz receiver, some circuit modifications may be required. The AGC voltage for the dual diversity receiver is applied to IC4a via a 3.3kΩ resistor and requires a voltage that rises with the strength of the signal. No signal is represented by 0V.

In your receiver, the AGC voltage may be inverted and offset from 0V. If so, it would have to be level shifted and inverted by op amp level circuitry. Adjustment of the gain is done by changing the 220kΩ resistor between pins 5 and 7 of IC4a.

different brand stamped on them. They were made in Malaysia and carried an ST brand name. (Silicon Technology?)

The other discovery was the LM339 quad comparator IC. It was a DBL339! Now it could have been the same thing but I replaced it with a proper LM339, fitted the new ST brand FETs and gingerly switched on. The inverter now works like a bought one!

With a 40W load, there is 230VAC on the output and with a 60W load, 200VAC precisely. After several hours use, the heatsink barely gets warm. I am very pleased with the circuit.

There is, however, a valuable lesson in this. I bought the components from a small Melbourne firm. They used to be cheap but not any more! In fact, I no longer deal with them. (N. B., Canterbury, NSW).

• Component substitutions are always a concern to us, as they can lead to disappointment for the constructor. In this respect you are almost always better off buying a kit if it is available, rather than obtaining parts from other outlets.

Upgrading the 45V 8A power supply

I am considering building the 0-45V 8A power supply featured in the January 1992 issue but I have the following questions:

(1) Can the optical link (IC1/LED1) be replaced with an optocoupler, with a suitable buffer transistor to provide some gain on the output to drive Q2, if necessary? The optical link arrangement seems to be a slight overkill and is not readily available here whereas optocouplers are. If this is practical, what type of opto would you recommend and how would you configure it? I realise that this modification would need to be mounted on a subboard off the main PC board.

(2) The transformer I intend to use has a lower output at 25V AC but has a higher current capability at 450VA. What I would like to do is raise the overall specs by two amps; ie, full current at 10A with foldback occurring at 11A. The switchmode part of the circuit appears able to sustain this increase, so it would only seem necessary to alter the point at which foldback occurs. This could be done by altering the voltage divider network consisting of the 22kΩ, 27kΩ, 820Ω and 1.1kΩ resistors so that it now senses 0.55V across R1/R2, corresponding to 11A. Assuming this is practical, which resistors would you change and to what values?

To enable the current limiting to pass 10A before it limits, my calculations indicate that the 270kΩ resistor above VR1 needs to be changed to 243kΩ. This will allow the voltage at the non-inverting input of IC5b to reach approximately 0.52V, which for the same voltage developed across R1/R2 would mean a current through the latter of just over 10A.

Your comments and suggestions would be much appreciated. (S. W., Hamilton, NZ).

• The reason we have used the optical link was to obtain sufficient speed to drive the switching Mosfet. If you can obtain a really fast optocoupler (most are relatively slow), you could probably substitute it without too many problems. If we were to redesign the power supply today, we would probably use a high-side switching IC.

We would be wary about increasing the output of the power supply, even only marginally. The main switching inductor has proved to be critical in this design and we would not like to prejudice its reliability.

Float switch for a jet ski

I am interested in building an electronic float switch for a bilge pump in a jet ski. I cannot fit a normal float switch as I'm limited for room. Would you be able to supply me with a circuit diagram of one or advise me of where I could get one, please? (F. D., Innisfail, Qld).

• We have published three circuits for bilge pump controllers, in December 1989, February 1990 and March 1990. In each case they employed the National Semiconductor 1830 fluid sensor IC. The most appropriate circuit

for your application would be the March 1990 design which featured a 15-second sloshing delay. All the circuits referred to were published in the Circuit Notebook pages and so no PC board designs are available.

Query on variable ignition timing

My query is related to John Clarke's Knock Indicator for leaded-petrol engines, as featured in the April 1996 issue. I own a 1980 Volvo 264 GLE with the Bosch K-Jetronic mechanical fuel injection system and the Bosch contactless electronic ignition. This is the V6 engine used in Volvo, Renault & Peugeot cars and in some of the later Volvos in an EFI version. As was usual in those days, the engine was designed to run on 97RON leaded petrol and had a reasonably high compression ratio.

I had to do a recent valve regrind and decoke on the engine and having restored it to full compression again, it now "pings" at a specific rev range on a very light throttle, exactly as John Clarke has described. I define a "ping" as more a "breaking glass" type sound as opposed to a "knock" or heavy "pinking". Fortunately, it does not knock or ping at any other point except at about 3000 revs with a high manifold vacuum, which equates to just over 80km/h.

If the vacuum advance is disconnected, there is no ping at all, confirming that somewhere along the extra 10 degrees of advance provided by the vacuum unit, it is too advanced for the lower lead petrols available today. However, the vacuum unit is necessary for good performance throughout the rev range. This engine/ignition has a very aggressive advance curve with very high advance figures in the mid to higher rev range.

I have just purchased the Knock Sensor kit from Jaycar electronics after seeing just such a kit in operation on another car and am impressed by its performance. Before I put this kit together, may I ask for the possibility of an extension to the design?

The circuit provides 10 points of reference when pinging occurs, to trigger the LED displays. Could one or all of these points be utilised to trigger a time-delay circuit inserted between the distributor and the electronic ignition amplifier unit to effectively retard the spark timing by a specific factor when pinging occurs? Once the pinging ceases, the delay unit would pass the distributor impulse straight through the amplifier as normal.

This would have the effect of dynamically modulating the impulse signal only if and when required and would alleviate the need to start tampering with the advance weight springs in the distributor. Please believe me when I tell you (through experience) that tampering with the advance curve in this manner on an engine like this is a horrendous task, even with access to the appropriate distributor timing machine levels. Besides, I only have the problem at a specific rev range.

I appreciate that I could fit the entire electronic kit described in a previous edition of SILICON CHIP and do away with the existing ignition control unit but arriving at the desired advance curve with this new unit is a very daunting task. Bosch Australia is a very helpful organisation but they just do not have all this data for the older cars (I have tried). (G. D., Berowra Heights, NSW).

• Your suggested concept of using the Knock Indicator to modulate the ignition advance curve is certainly feasible and is the same principle as used in cars with full engine management systems.

However, designing such a system with hardware would be quite complex. Nor could we necessarily produce a circuit which would be compatible with the many ignition systems available.

Multimedia power worries

I am interested in making the Multimedia Amplifier featured in the October & November 1996 issues of SILICON CHIP. However, I am concerned because the circuit has been described to me as a most irresponsible design as it takes absolutely no account of the limitations imposed by most computer power supplies.

Is this a reasonable comment? What would be the maximum additional load that the power supply would be expected to deliver during normal use of the amplifier? (L. S., Kenthurst, NSW).

• As far as power supply capacity is concerned, we would not have published the project if there was any risk of running computer power supplies into overload. The typical computer power supply these days is rated at 250 watts and this usually includes 5V 20A (100W) and 12V 12A (144W) supply rails. A typical 1.6GB drive consumes 0.4A at 5V and 0.27A at 12V DC. A typical CD-ROM drive might pull 1.8A at 5V and 1.5A at 12V.

Unless your computer is loaded up with lots of accessory cards and has perhaps two or three hard disc drives, CD-ROM, etc your computer's power supply will have lots of current capacity to spare. By way of comparison, we would expect the total current drain of the multimedia amplifier card to be less than 250mA for virtually all of the time.

Even if all amplifiers were driven into serious clipping simultaneously, which should never happen, the total current drain would be no more than about 2A at the maximum. If you did manage to drive the multimedia amplifiers into serious overload, their own protection circuitry would quickly shut them down.

In any case, your computer's power supply has overload protection and in the event of a serious overload, which is very unlikely to be due to the multimedia amplifier card, the worst that might happen is that your hard disc might slow down momentarily.

Notes & Errata

Multimedia Amplifier, October 1996: There is an error with the test procedure for the PC board. Without the power link installed, pins 1 and 9 of IC3, IC4 and IC5 are at about +0.5V and pin 7 is at +12V. No voltage is present on the other pins. With the link in, pins 1 and 9 are at about +2.2V; pins 3, 4 & 6 are at +5.6V; and pin 7 measures +12V. **SC**

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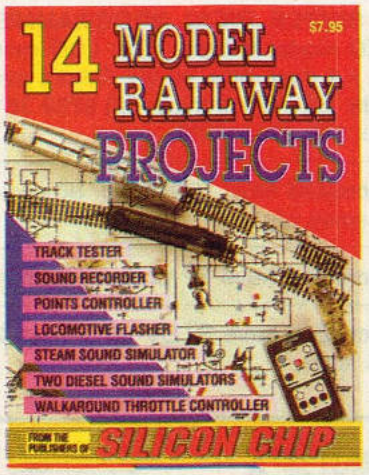

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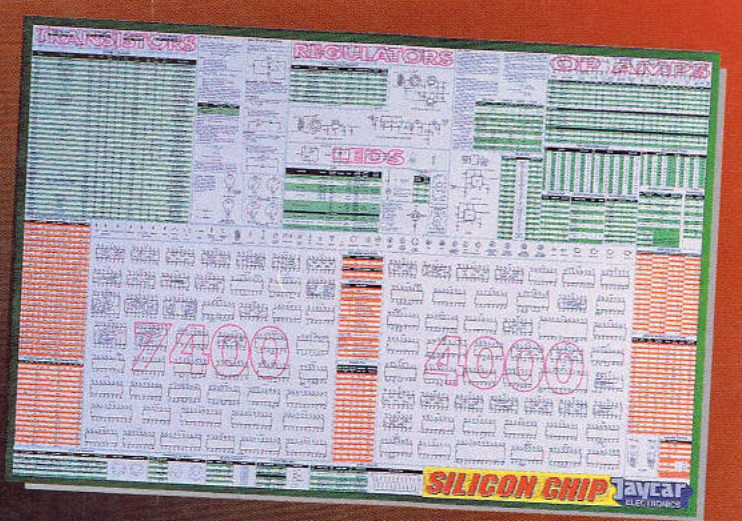

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